

CHINA.

IMPERIAL MARITIME CUSTOMS.

II.—SPECIAL SERIES: No. 2.

MEDICAL REPORTS,

FOR THE HALF-YEAR ENDED 30TH SEPTEMBER 1881.

22nd Issue.

PUBLISHED BY ORDER OF

The Inspector General of Customs.

SHANGHAI:
STATISTICAL DEPARTMENT
OF THE
INSPECTORATE GENERAL.

MDCCLXXXII.

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IF-SPECIAL SERIES: No. 2.

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FOR THE HALF-YEAR ENDING SEPTEMBER 1931

2nd Issue

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INSPECTOR GENERAL'S CIRCULAR No. 19 OF 1870.

INSPECTORATE GENERAL OF CUSTOMS,

PEKING, 31st December 1870.

SIR,

1.—It has been suggested to me that it would be well to take advantage of the circumstances in which the Customs Establishment is placed, to procure information with regard to disease amongst foreigners and natives in China; and I have, in consequence, come to the resolution of publishing half-yearly in collected form all that may be obtainable. If carried out to the extent hoped for, the scheme may prove highly useful to the medical profession both in China and at home, and to the public generally. I therefore look with confidence to the co-operation of the Customs Medical Officer at your port, and rely on his assisting me in this matter by framing a half-yearly report containing the result of his observations at.....upon the local peculiarities of disease, and upon diseases rarely or never encountered out of China. The facts brought forward and the opinions expressed will be arranged and published either with or without the name of the physician responsible for them, just as he may desire.

2.—The suggestions of the Customs Medical Officers at the various ports as to the points which it would be well to have especially elucidated, will be of great value in the framing of a form which will save trouble to those members of the Medical profession, whether connected with the Customs or not, who will join in carrying out the plan proposed. Meanwhile I would particularly invite attention to—

a.—The general health of.....during the period reported on; the death rate amongst foreigners; and, as far as possible, a classification of the causes of death.

b.—Diseases prevalent at.....

c.—General type of disease; peculiarities and complications encountered; special treatment demanded.

d.—Relation of disease to $\left\{ \begin{array}{l} \text{Season.} \\ \text{Alteration in local conditions—such as drainage, \&c.} \\ \text{Alteration in climatic conditions.} \end{array} \right.$

e.—Peculiar diseases; especially leprosy.

f.—Epidemics $\left\{ \begin{array}{l} \text{Absence or presence.} \\ \text{Causes.} \\ \text{Course and treatment.} \\ \text{Fatality.} \end{array} \right.$

Other points, of a general or special kind, will naturally suggest themselves to medical men; what I have above called attention to will serve to fix the general scope of the undertaking. I have committed to Dr. ALEX. JAMIESON, of Shanghai, the charge of arranging the Reports for publication, so that they may be made available in a convenient form.

3.—Considering the number of places at which the Customs Inspectorate has established offices, the thousands of miles north and south and east and west over which these offices are scattered, the varieties of climate, and the peculiar conditions to which, under such different circumstances, life and health are subjected, I believe the Inspectorate, aided by its Medical Officers, can do good service in the general interest in the direction indicated; and, as already stated, I rely with confidence on the support and assistance of the Medical Officer at each port in the furtherance and perfecting of this scheme. You will hand a copy of this Circular to Dr., and request him, in my name, to hand to you in future, for transmission to myself, half-yearly Reports of the kind required, for the half-years ending 31st March and 30th September—that is, for the Winter and Summer seasons.

4.—

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I am, &c.,

(signed)

ROBERT HART,

I. G.

THE COMMISSIONERS OF CUSTOMS,—*Newchwang, Ningpo,*
Tientsin, Foochow,
Chefoo, Tamsui,
Hankow, Takow,
Kiukiang, Amoy,
Chinkiang, Swatow, and
Shanghai, Canton.

SHANGHAI, *1st March 1882.*

SIR,

IN accordance with the directions of your Despatch No. 6 A (Returns Series) of the 24th June 1871, I now forward to the Statistical Department of the Inspectorate General of Customs, the following documents:—

Report on the Health of Amoy, pp. 1-3;

Report on the Health of Swatow, pp. 4, 5;

Report on the Health of Hoihow, pp. 6-10;

Report on the Health of Chefoo, pp. 11, 12;

Report on the Health of Ningpo, p. 13;

Report on the Health of Wenchow, pp. 14-50;

Report on the Health of Shanghai, pp. 51-54; each of these referring to the half-year ended 30th September 1881.

Special articles on—

Distoma Ringeri and Parasitical Hæmoptysis, pp. 55-62.

The Periodicity of Filarial Migrations to and from the Circulation, pp. 63-68.

An Appendix of translations and notes relating to recent pathological investigations, which are of special interest to medical practitioners in China, pp. 69-104.

I have the honour to be,

SIR,

Your obedient Servant,

R. ALEX. JAMIESON.

THE INSPECTOR GENERAL OF CUSTOMS,
PEKING.

The Contributors to this Volume are:—

P. MANSON, M.D., CH.M.	Amoy.
J. POLLOCK, L.K.&Q.C.P., L.R.C.S.I.	Swatow.
E. A. ALDRIDGE, L.K.&Q.C.P.	Hoihow.
J. G. BRERETON, L.K.&Q.C.P., L.R.C.S.I.	Chefoo.
W. A. HENDERSON, L.R.C.P.Ed.	Ningpo.
D. J. MACGOWAN, M.D.	Wênchow.
R. A. JAMIESON, M.A., M.D., M.R.C.S.	Shanghai.

For everything enclosed within square brackets [], the Compiler is responsible.

Dr. P. MANSON'S Report on the Health of Amoy for the Half-year
ended 30th September 1881.

THERE has been no epidemic either among foreigners or natives, and the general health of the community during the six months has been good.

The deaths were as follows:—

- | | |
|---|--------------------------------|
| 1. Resident (for two months) | Aneurism of the aorta. |
| 2. Sailor | Valvular disease of the heart. |
| 3. „ | Aneurism of the aorta. |
| 4. „ | Valvular disease of the heart. |
| 5. Child, resident (eight months) | Diarrhoea and fever. |

The first four cases acquired their diseases elsewhere; the last is the only one attributable to Amoy. Another might be added, but as it will probably appear in the Shanghai returns I omit it here. The cause of death, dysentery and secondary multiple abscess of the liver, originated in Amoy.

Aneurism of the Ascending Aorta.—The first case of aneurism occurred in the Customs out-door staff, and had but lately (29th March) arrived from Hankow.

Some weeks after his arrival he consulted me about a chronic irritation of the fauces which had troubled him for about two years, and for which he had been trying a variety of local applications. He also complained of slight attacks of what he called asthma, coming on especially at night, and some breathlessness experienced on going upstairs. I failed to detect any disease in his throat, and repeatedly examined his chest, with the possibility of aneurism present to my mind, but could detect no objective symptoms whatever.* On 22nd May, feeling perfectly well, he went out riding with some friends. He had ridden but a little way, and got about 100 yards in advance of his party, when he was seen suddenly to drop from the saddle and fall on his face in the sand. He breathed heavily, his face became black, and in a few minutes he died.

A postmortem examination was made about four hours after death. The pericardium was distended with blood clot and serum. An aneurism—sacculated, and with a large opening into the artery

* As a result of a good many years' experience and more than one unpleasant surprise, I have formulated for myself two rules which I can confidently commend to anyone commencing practice among foreigners in China.

1st. Given a *non-febrile* case in which persistent symptoms—no matter how trifling—point to disease in the chest (especially if there is laryngeal irritation), and the cause for which cannot be readily made out, suspect aneurism of the aorta, and carefully and repeatedly examine for this.

2nd. Given a *febrile* case of some standing in which symptoms—no matter how trifling—point to disease in the abdomen, the exact nature of which cannot readily be diagnosed, suspect abscess of the liver, and carefully and repeatedly examine for this.

Those who have practised in China for any length of time become thoroughly impressed with the extreme frequency of aneurism of the aorta and abscess of the liver among foreigners, and hardly ever approach the diagnosis of an obscure case without being on their guard about these two diseases. But, unless impressed by some such rule as I have formulated, the novice, with only European experience to guide, or rather mislead, him, is very apt to overlook these important possibilities, and may have them afterwards very unpleasantly impressed on him. A pulsating tumour bulging out from the thorax, or a fluctuating swelling in the region of the liver are easily recognised and diagnosed; but it is seldom indeed, unless when disease has advanced so far that treatment has become entirely hopeless, that the aneurism or the abscess declares itself so openly.

extending from the semilunar valves nearly as far as the origin of the innominate—had burst into the pericardium by a minute rent behind the appendix of the right auricle. The aneurism—about the size of a small orange—sprang from the lower and back part of the artery, and pressed slightly on the trachea just above its bifurcation, but had caused no erosion or ulceration. There were many patches of atheroma along the aorta; these could easily be turned out with the finger-nail after stripping off the inner coat. The patches increased in number, size and degree of degeneration, in proportion to their nearness to the aneurism. The inner surface of this was rough and irregular from atheromatous deposits, some of which were much eroded, and in their ragged, ulcerated-looking centres presented a dark red staining. In some places this process had so weakened the walls of the tumour that small subsidiary aneurisms had formed—little pouches with narrow openings hardly admitting the tip of the little finger. There were at least three such baby aneurisms, two of them adherent to the auricle or pericardium. The rent in the wall of the aneurism was very small; but, besides that which had caused death, there was a second, much more extensive, not, however, penetrating all the walls of the sac, but dissecting them up to a considerable extent. There were no laminated coagula, nor, beyond a certain amount of thickening in the tissues around the tumour, any attempt at spontaneous cure. The origin of the innominate was barely involved. The heart was quite healthy; lungs somewhat emphysematous; liver large and full of blood. The dissection proceeded no further.

This man, though considerably over 40, was active, in good general health, very temperate, and he told me he had never had syphilis.

Aneurism of the Transverse Aorta.—A sailor, aged about 31, active, muscular, and temperate, consulted me early in March about a cough that had troubled him for some time. He said he caught a bad cold early in January; that towards the end of that month, once or twice, when exerting himself, his wind failed him; that during February he had several similar attacks of breathlessness; that previously he had been treated for specific disease—had had iritis, some periostitis about the sternum and ribs, and that last year he suffered much from pains in the head and rheumatism. Just before my examination he had been walking up rather a steep road, and I observed that his breathing was much oppressed. There was no expectoration with the cough. Examination failed to elicit any distinct sign of thoracic disease, although, owing to my suspicion of aneurism, this was made with the greatest care. I saw him again about a week later, and then heard for the first time a distinct, soft, systolic bruit over the second and third intercostal spaces, just to the left of the sternum. At the beginning of April I saw him again. He told me that he had had several very severe attacks of dyspnoea while at sea, and had been much troubled at times with paroxysms of coughing, unaccompanied by expectoration. It was possible now to diagnose thoracic tumour, probably an aneurism. Pressure symptoms had developed; he had difficulty in swallowing, pain behind left shoulder, a husky raucous voice and breathing. Slight dulness on percussion could be made out over the second left cartilage; bruit was audible here also, and could be traced along the course of the vessel, and could also be made out posteriorly. There was a slight heaving movement of the sternal end of the left clavicle and one or two of the upper ribs; and in addition to these symptoms the breath sounds of the left lung were decidedly feebler than those of the right.

He was sent to bed and kept as much as possible in the recumbent position. His food was restricted, and only a very small allowance of fluid permitted; and iodide of potassium, in doses rapidly increased to a drachm, was taken three times a day. Great relief followed this treatment. By the middle of June cough had entirely ceased, the difficulty in swallowing, and pain in the shoulder had disappeared, and the heaving at the sternal end of the left clavicle could hardly be detected. Before this, however, he had hawked up on three or four successive mornings small quantities of rusty bloody mucus. He was so well that arrangements were made to send him home, with the view of continuing the treatment there among his relatives. But 10 days before his death a severe attack of coughing was brought on by a piece of bread "going the wrong way," and next day I observed that throbbing and heaving had returned. Three days afterwards his voice became very husky, and he had an alarming attack of orthopnoea. These

attacks recurring frequently, and provoked by the slightest movement, as even by swallowing, brought about his death by exhaustion on the 2nd July.

At a postmortem examination, an aneurism the size of a goose's egg, with an orifice the size of half a crown, was discovered springing from the under and back part of the distal half of the transverse aorta. The orifices of the innominate and left carotid and subclavian were not involved. The walls of the aneurism were strengthened everywhere by an extensive deposit of laminated dirty yellow fibrine, which could be peeled off in long strips, and was intimately connected with the vessel. In some places it was quite three-quarters of an inch in thickness. Its inner surface was very irregular, and stained with blood. Half an inch above the bifurcation an aneurismal mamilla projected into the lumen of the trachea. The little tumour appeared to be covered by mucous membrane only. It was rough, blood-stained, and looked as if on the point of rupture. There was some fibrine strengthening it, but this appeared to be the weakest point in all the aneurism. About three-quarters of an inch above this mamilla was another but smaller projection the size of a B.B. shot; its surface was smooth and much healthier looking than the other. There was great abundance of atheroma in the arch of the aorta. The lungs were healthy. None of the other viscera were examined.

Notwithstanding the fatal issue of this case, the rapid amelioration of symptoms and the extensive deposit of fibrine have impressed me very favourably with the iodide of potassium treatment of aneurism.

Dr. J. POLLOCK'S Report on the Health of Swatow for the Half-year
ended 30th September 1881.

I AM indebted to Mr. Harbour Master RAE for the following meteorological observations:—

ABSTRACT from METEOROLOGICAL TABLE.

MONTH.	WINDS.					MERCURIAL BAROMETER.				THERMOMETER.						RAIN AND FOG.			TIDES.	
	Number of Days N. to E.	Number of Days E. to S.	Number of Days S. to W.	Number of Days W. to N.	Number of Days Calm.	Highest by Day.	Lowest by Day.	Highest by Night.	Lowest by Night.	Highest by Day.	Lowest by Day.	Highest by Night.	Lowest by Night.	Average Wet Bulb.	Average Dry Bulb.	Number of Days Rain.	Number of Inches Rainfall.	Number of Days Fog.	Average Rise, Spring Tides.	Average Rise, Neap Tides.
	D. h.	D. h.	D. h.	D. h.	D. h.	Inch.	Inch.	Inch.	Inch.	°	°	°	°	°	°	D. h.	Inch.	D. h.	Ft. in.	Ft. in.
April	10 8	11 4	1 20	1 4	5 12	30.30	30.00	30.30	30.00	80	62	79	54	65	70	3 12	3.165	2 12	7 0	6 3
May	11 0	10 20	4 4	4 4	4 20	30.30	29.91	30.30	29.90	89	65	82	68	75	80	3 6	2.405	0 4	7 6	4 6
June	2 12	10 20	11 0	0 16	5 0	30.07	29.83	30.95	29.80	87	72	89	72	80	85	1 3	3.720	...	7 3	6 0
July	4 16	17 14	3 12	...	5 6	29.92	29.86	29.89	29.84	85	84	83	82	80	83	2 20	5.072	...	6 8	5 7
August	4 13	12 7	8 9	2 2	3 17	29.87	29.70	29.84	29.70	87	84	83	82	82	84	3 3	4.005	...	6 3	5 6
September...	5 16	14 0	2 4	3 16	4 12	30.13	29.48	30.10	29.48	94	79	88	78	80	82	1 8	1.001	0 1	6 9	5 6

Note.—Tides very irregular; not to be depended on, being greatly influenced by the winds.

Among foreign residents there have been no cases of peculiar interest since I arrived in November last, with the exception of a well-marked case of diphtheria occurring in a child aged 5 years. My colleague, Dr. E. I. SCOTT, saw the case with me, and concurred in the diagnosis.

The treatment consisted in brushing the affected parts with glycerine of tannic acid regularly every hour, inhalations of steam, poultices, and internally quinine and iron. I tried for a short time a solution of chloral in glycerine, but the result was not at all so satisfactory as the glycerine of tannin, the membrane not appearing either to be dissolved or detached to an appreciable extent by it.

The child eventually recovered, and, under a course of cod-liver oil, regained his usual health. His mother was attacked with tonsillitis while nursing him, and I myself had an ulcer on my right tonsil. The other children of the house, which is situated in a bad locality, were sent to Double Island, where they remained till all likelihood of infection had ceased.

There has been one case of typhoid fever in a child aged 7, and a rather severe case of continued fever in a child aged 2 years, both of which made uninterrupted recoveries.

At Double Island an outbreak of varicella occurred among the resident children, seven of whom were attacked. The eruption was copious, and there was very little constitutional disturbance. All became quickly convalescent.

Among the other cases were dysentery, delirium tremens, complicated with cirrhosis of the liver—one case of each. There was one death among the residents, from chronic tuberculosis of lung and intestine.

Four births have taken place, all natural, with one exception, where the placenta was retained, necessitating extraction. This last patient had a very foetid, purulent discharge, slight rigors, and quick pulse, but, under quinine and iron internally, and frequent carbolised injections, I am happy to say made a good, though tedious, recovery.

In the Swatow Seamen's Hospital a case of hepatic abscess terminated fatally; aspiration was performed, but the patient, who was a young engineer of temperate habits, was already moribund on admission.

The European lightkeeper from the Lamocks station arrived in harbour one evening perfectly unconscious, with temperature 105°, physical signs of broncho-pneumonia; phimosis, and retention of urine. He died a few hours after admission to hospital. His illness was described as having commenced 10 days before with "fever," followed by low delirium.

A coloured seaman was admitted, who had been stabbed in the back and head during an affray with drunken sailors. When I saw him, shortly after the receipt of his injuries, he had an incised wound over the right parietal bone, and a punctured wound, about 3 inches long, immediately below the inferior angle of the left scapula, through which air bubbled at each respiratory movement. As the wound looked perfectly clean, I put three carbolised sutures in, and hermetically sealed it with lint steeped in compound tincture of benzoin; and on the removal of the lint five days after, I found the wound closed. The patient had a slight attack of pleuritis, but in a fortnight was convalescent.

The cook of a steamer, a Chinaman, was admitted for dropsy of the abdomen, which was enormously swollen, and respiration greatly impeded. No measurements were taken. Paracentesis abdominis was performed, and 284 ounces of blood-stained fluid was evacuated. The patient recovered sufficiently to proceed to Hongkong, to rejoin his family.

Dr. E. A. ALDRIDGE's Report on the Health of Hoihow for the Half-year
ended 30th September 1881.

THE health of the small foreign community resident here has during the last six months been very good. There have been two or three cases of very acute diarrhoea, but under active treatment this complaint was always promptly checked. All other affections were of a trivial character. That diarrhoea has not been more prevalent, considering how common this complaint has been among the native population, may be somewhat due to the sensible view taken of the precautionary measures suggested by myself, and the trouble taken in order to carry them out. The summer has been very long and trying. Since April, except on two or three occasions, the thermometer has never registered below 82°. So long as foreigners here live in Chinese-built houses, and the breeze that is usually blowing is kept off by their houses being surrounded by others, they will find at the end of every summer that their constitutions have been enfeebled by excessive perspirations, sleepless nights, etc. Were they, however, to live in detached houses built on elevated ground, I feel sure that a summer's residence here would be little more trying to the constitution than in other ports in China.

As soon as I found that cholera had broken out here, I informed the foreign residents of the precautions it would be advisable for them to take. Of these the more important were that water should not be drunk without having been previously boiled and filtered, and even when so treated should not be drunk after standing more than 24 hours, and that it was a mistaken idea to suppose that water, by being diluted with wine or spirit, without being previously boiled and filtered, was rendered harmless. I advised that a broad thick flannel belt, even if not worn in the daytime, should always be worn at night, while the sleeping clothes should be made of flannel; that exposure to night air should be avoided, and therefore sleeping on the verandahs abandoned, and that care should be observed in diet, shell-fish and fruit being forbidden. I advised, in addition, that a bucket of carbolic acid and water should be placed in each bathroom, for the purpose of disinfecting all excreta, which should then be quickly removed, while the drains should be frequently flushed with carbolic acid solution. I warned them against the premonitory painless diarrhoea, against the amateur use of purgatives, against exposure to the sun and to the emanations from the narrow streets. I further asked them to impress my recommendations upon the minds of their native servants, and advised that should any of these latter complain of diarrhoea, vomiting, or of any other sickness, they should at once be removed. It will be noticed that I recommended the residents to walk as little as possible along the streets. Not to do so at all was quite an impossibility, situated as the houses are, the front entrance to all of them being from a Chinese street. During the last few months, if business did not compel one to leave the house, it became a question whether one should remain in-doors and forego the pleasure of taking any out-door exercise, or experience the unpleasantness of having to walk along streets where the pestilential odours emanating from the drains and the refuse thrown from the houses must have greatly favoured the spreading of a disease such as

cholera. This condition of the streets was greatly aggravated at the time of the Yü Lan (All Souls) festival by an increase in the number of fruit and vegetable sellers lining the streets, who, owing to a great influx of strangers into Hoihow, seemed to do a good business; but instead of their taking the trouble to remove the fruit and vegetables as soon as they became unfit to eat, and hence unsaleable, they threw them into the gutters and let them rot there.

There were three or four cases of heat apoplexy and a case of intermittent fever on board H.B.M.S. *Magpie* during her stay here, but there were no deaths. The French gun-vessel *Parseval* arrived here from Haiphong with a mild case of typhoid fever; the man was not landed. With reference to the diseases that have occurred among the native population in Hoihow during the period under review, the most important thing that I have to report is that there has been an epidemic of Asiatic cholera. In the middle of July a steamer direct from Bangkok, where cholera was at the time prevalent, arrived here and landed 270 passengers. Soon after I was informed by the Chinese that several natives were dying of a disease which they believed to be cholera, and this information was subsequently confirmed by myself. Though no information was given to anyone here of the fact, the newspapers reported that two deaths had occurred on board from cholera during the voyage; and as cholera showed itself near Pochin, where several of the passengers went to reside, the presumption is that cholera was brought to the island by the passengers conveyed here by the steamer from Bangkok above referred to. Though I feel sure that there had been several deaths from Asiatic cholera previous to the 8th August, it was not until that date that I was called in to see any well-marked case and was able to speak with certainty as to the nature of the epidemic.

At 4 o'clock in the afternoon of the 8th August I visited a woman, aged 46, who up to 1 P.M. had been in good health, at which time she first complained of pain in the abdomen, which was followed by vomiting, diarrhoea, and cramp in the legs. I found her lying on the ground, speechless; she was, however, quite conscious, and made motions with her hands for me to give her something. The surface was cold, the eyes shrunken, cheeks hollow, lips and nails blue, skin at tips of fingers shrivelled, colour of body dark, pulse imperceptible at wrist, and could only be feebly felt at the carotids; temperature 95°; the breath was very cold; there had been 15 motions, principally composed of large quantities of fluid, in which were floating numerous white flocculi. The patient died at 6 o'clock, five hours from the onset of symptoms.

Though the cases I saw afterwards differed little from this, I report this as being most typical of the disease.

On the same day that I saw the above case I found one of the Custom House coolies in a state of semi-collapse; he was much emaciated, and when questioned answered with a feeble voice. He complained of headache and great thirst; there was abdominal pain and retraction of the abdomen; pulse feeble; temperature 97°; conjunctivæ yellow. I was informed that the diarrhoea and vomiting which were present when I saw him had commenced two days previous; the motions were of a very watery character. Upon visiting him the following day the pulse was 68, temperature 97°.2; the vomiting had been checked by dilute hydrocyanic acid, and the diarrhoea by astringents. Two days after this his temperature was normal, and he made a good recovery. When first taken ill this man was suffering from mumps.

To give an idea of how quickly fatal the disease was in some cases, I may state that within 24 hours three persons in one house died: a boy, 7 years old, in 4 hours after the first symptoms; a man, aged 30, in 6 hours; and a woman, aged 25, in 5 hours. The day after, I saw another woman in the same house who was attacked with diarrhoea; she, however, recovered.

Upon making inquiries I found that the water these people had been in the habit of drinking was obtained from a well situated alongside the drains of one of the main streets. As stated in my last Report, water fit for drinking cannot be obtained in Hoihow; but though this is so, many of the Chinese prefer to drink the foul water close to their houses, rather than take the trouble of bringing drinking water from the springs a short distance from the town. Considering the way the natives here neglect the most simple sanitary precautions, it is not to be wondered at that a disease like cholera should spread among them; in fact, I think it is surprising that the ravages of this epidemic have not been of a more serious character. I found that most of those who died had obtained their drinking water from wells situated either in their yards or within a short distance of the street drains; I also heard that the disease proved fatal to many who had over-fatigued themselves by being up most of the night, sitting or standing, exposed to the night air in front of the Chinese theatres, and who had afterwards returned home, and after drinking large quantities of water and eaten unripe fruit, such as pineapple and water-melon, had then gone to sleep in the open air, only scantily clad. I cannot say that I found diarrhoea a symptom that could guide one in giving a favourable or unfavourable prognosis; though the motions were in fatal cases mostly very numerous, I found that this was not always so, death in some cases taking place after only two or three.

H.B.M.'s Consul, upon receiving information from me that Asiatic cholera had shown itself here, reported the circumstance to the Hongkong Government. The epidemic here was, however, not considered of sufficiently serious a character to require the subjection to quarantine of vessels arriving from this port, though I believe vessels from Bangkok were for a short time quarantined.

The filthy condition of the town was brought under the notice of the Taotai, who issued a proclamation ordering the natives to clean their streets and not to let them get into the same condition again; he also instructed the police to go round and see that his orders were obeyed. In addition to the recommendations that I issued to the foreign residents, I warned the Chinese against drinking the Hoihow well water, and advised that during the epidemic the excreta should not be used to manure the fields, as is usually done, but that they should be buried. I further suggested that as earth acts somewhat as a deodoriser, they should keep some in their houses and put some in the buckets after use; also, that should a death occur, the corpse should be buried as quickly as possible.

I have been unable to obtain any accurate information respecting the mortality from cholera, as the authorities do not keep any returns. I am, however, informed that there have been about 400 deaths from this cause. The population of Hoihow is estimated at about 12,000, so that giving 10 as the average number of persons to each house, though this is probably under the mark, it may be said that there has been on an average one death from cholera in every third house. It is worthy of remark that only one death from cholera occurred among the numerous Cantonese residents, whose mode of living is more cleanly than that of the natives. They do not eat so much unripe fruit, and are more particular respecting the place from which they obtain their drinking water. During the epidemic, diarrhoea and vomiting were prevalent; the diarrhoea being peculiar not only on account of its very watery character, but also because of the great prostration it quickly caused. After trying different astringents, I came to

the opinion that sulphuric acid and opium gave the best results, and I believe that it is not improbable that some of these cases might have run into cholera had they not been so treated. In August another vessel arrived with passengers from Bangkok, but on boarding her I found that there had been no sickness during the voyage. Cholera spread from here to Kiungchow, but its course there was very mild. The average number of deaths per diem here was about 10; this number gradually decreased during September, and at the latter end of that month the deaths from cholera were only about three daily.

During June and July I noticed many cases of mumps among the Chinese, adults as well as children being attacked.

I have attended two persons suffering from the effects of snake-bite, the bites in both cases being inflicted by the bamboo snake. These snakes are very common in this neighbourhood, and on account of their green colour are often trodden on by the natives, who walk through the grass without shoes.

In one case a man was bitten on the ankle. He came to me 12 hours afterwards; he was very feverish, and complained of pain extending up the leg and thigh. There was an œdematous swelling reaching to the knee, and the skin over the foot was tense; he was unable to straighten the leg. I made a crucial incision over the bite, applied hot fomentations to the foot and leg, and kept him in bed; but it was four days before he was able to return to work.

This man immediately after being bitten had taken a large quantity of Chinese wine. I hear that to become intoxicated is considered the best line of treatment that can be adopted in cases of snake-bite.

The other case I saw was very similar to the first; a woman was bitten on one of the toes, and the virus produced the same results. I made a crucial incision over the bite, applied nitrate of silver and then hot fomentations, with a favourable result.

The new Taotai that arrived at Kiungchow in April died two months afterwards; his death, I believe, being from exhaustion, the result of diarrhœa and hæmorrhoids. I heard that seven native doctors were called in to attend him, and that they were all afraid to administer any of their drugs, fearing lest his death should take place at the time he was under their treatment.

In July a passenger-boat left this port for Haian, a place on the mainland about 12 miles from here, with 28 Chinamen, among whom were 10 pirates, who soon after leaving here rose and murdered all the passengers, except a man and boy, who escaped overboard. The pirates then took possession of the junk, the cargo of which was worth about \$12,000. The man and boy that escaped were picked up by fishing-boats. Hearing that the man had been injured, I visited him, and found that he had received a stab in the anterior axillary fold. The wound was not a deep one, but there was a great deal of areolar inflammation extending down the side and front of the chest; this cellulitis was probably increased by the exposure of the wound to the action of the salt water. Hot fomentations reduced the inflammation, and in a week he was quite well.

I have been called upon to attend one Chinese woman, a primipara, in labour. The case having proved very protracted, the friends became alarmed. No operative interference was, however, required, and the woman made a good recovery. From Chinese sources I learn that it is a most unusual thing to hear of a bad midwifery case in this part of the island.

I have heard nothing since April of the epizootic that caused so much havoc among the cattle previous to that time, so I suppose that it has died out.

During the first three months under review we had some very violent thunderstorms, which usually took place between the hours of 2 and 4 P.M., with heavy rain and vivid lightning. I heard of two or three persons having been killed by lightning. During the last six months I consider that the temperature has averaged about 85°. In July we had two gales and in August one, but so far this year we have not experienced any typhoons; the lowest reading of the barometer was 29.63, which was recorded during a S.E. gale. During the last twelve months the wind has blown from N. to E. on 230 days, from E. to S. on 63 days, from S. to W. on 13 days, and from W. to N. on 30 days. Thus it will be observed that only on 76 days has there been any southerly direction in the wind, while during 260 days there has been a northerly direction. This fact proves how little we are affected by the south-west monsoon, and that the wind here is of more or less local origin during these months. If the south-west monsoon affected us, we should feel the heat a great deal more than we now do, and the place would not be so healthy, for the south-west wind, before reaching us, must blow over the island, while the northerly wind we have so often is essentially a sea breeze, having never to blow over more than a very small stretch of land before arriving here. Rain has fallen on 77 days, 55 of which have been during the last six months; the rain we have had has usually attended a thunderstorm, and has rarely lasted above an hour or two a day. The water in the river opposite the Custom House has on an average been 1 foot 8 inches higher from the beginning of July to the end of December than during the other half of the year.

The following meteorological table is drawn up from readings taken at the Custom House. Judging from the thermometers several foreign residents keep in their houses, by adding 2° or 3° to the readings given below, a more accurate idea of the temperature experienced by them would be arrived at:—

MONTH.	WINDS.							BAROMETER.		THERMO-METER.		No. of Days Fog.	No. of Days Rain.	AVERAGE RISE AND FALL OF TIDES.	
	No. of Days N. to E.	No. of Days E. to S.	No. of Days S. to W.	No. of Days W. to N.	No. of Days Variable.	No. of Days Calm.	Average Hourly Force.	Highest and Average Highest.	Lowest and Average Lowest.	Highest and Average Highest.	Lowest and Average Lowest.			Highest.	Lowest.
							Miles.	Inch.	Inch.	°	°			Ft. in.	Ft. in.
April	10	15	2	...	3	...	3	30.20 29.98	29.75 29.81	93 84	67 76	...	10	4 0	3 6
May	14	10	...	1	6	...	2	30.15 29.98	29.72 29.86	95 85	74 81	...	7	4 6	4 0
June	15	11	...	1	3	...	3	29.95 29.88	29.71 29.83	95 90	76 81	...	13	5 0	4 6
July	11	4	4	5	7	...	3	29.90 29.80	29.63 29.78	87 84	79 82	...	8	5 6	5 0
August	6	5	6	10	4	...	2	29.93 29.83	29.84 29.78	88 85	79 82	1	14	6 6	6 0
September,.....	17	3	...	8	2	...	4	30.05 29.91	29.70 29.80	86 84	79 81	...	3	7 0	6 6

Dr. J. G. BRERETON'S Report on the Health of Chefoo for the Half-year
ended 30th September 1881.

For the following meteorological table I am indebted to Mr. JENNINGS, Harbour Master:—

MONTH.	1880.			1881.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
April.....	85	29	57	74	30	52
May.....	94	42	68	90	41	52
June.....	89	54	72	100	58	79
July.....	94	60	77	106	62	84
August.....	99	62	80	104	62	83
September.....	93	50	72	88	57	72

It will be seen that the heat has been greater this summer than during the corresponding period last year. We have also had a considerable increase in the number of cases of illness, and I have to record a very high death rate. The diseases treated during June and July were mostly cases of intestinal disorder, but these soon yielded to treatment, except in two instances which proved fatal.

The causes of death were as follow:—

- | | |
|------------------------|-----------------------------|
| 1. Inanition. | 5. Meningitis:—Dentition. |
| 2. Infantile diarrhœa. | 6. " " |
| 3. Gastritis. | 7. Peritonitis. |
| 4. Diarrhœa. | 8. Aneurism of aorta. |

of these, however, three were visitors.

The case of *aortic aneurism* which terminated fatally had been under treatment for about $2\frac{1}{2}$ years.

Previous to this for about a year, complaint had occasionally been made of "rheumatism" in the right shoulder, to relieve which various anodyne applications and blisters were employed, but none gave more than temporary relief. The pain then extended down the arm, and under the right scapula. The chest and back were carefully examined, but nothing definite could be made out, till about 18 months prior to death, when the nature of the disease became more apparent. The signs of aneurism then were, circumscribed dulness on percussion at right side of sternum and also second area of pulsation at costal cartilages of third and fourth right ribs. Up to this time there had been no hæmoptysis or cough, and only very slight dyspnœa upon exertion. Aneurism then being diagnosed, he was put upon the iodide and bromide of potassium with ergot, which was continued for about six months, gradually increasing the doses of each ingredient. Symptoms of softening of the brain then set in. Having replaced the bromide of potassium

by chloride of barium, a drug recommended by a writer in the *Practitioner*, I found after 10 days that it was not only useless, but that the chest pain always seemed intensified for some hours after each dose. Compound tincture of valerian was given with considerable benefit for about three weeks, when it lost its effect. Finally, hypodermic injections of morphia and atropia, separately and combined, had to be resorted to; these were continued up to the time of death. The immediate cause of death was rupture, the patient dying shortly after having coughed up about 6 ounces of blood.

At the autopsy, a portion of the sternum over the sac was found corroded; pericardium distended with fluid. The aneurism sprang from immediately above the semilunar valves, and occupied the right side of the ascending aorta as far as the innominate. The sac could easily contain an ordinary-sized orange; the wall was adherent to the lung on the same side. On opening the sac the portion of wall adherent to the lung was found ruptured, the opening being large enough to admit a dollar.* The interior of the sac did not contain the least trace of clot; the aorta was atheromatous.

Bullet Wound of Abdomen.—A Chinaman was wounded by a revolver bullet, which entered the abdomen 2 inches above and to the right of the umbilicus, and made its exit in the lumbar region, at the superior margin of the right kidney. A bullet similar to that with which the wound was inflicted weighs 180 grains, is conical in shape, and measures two-thirds of an inch in height and five-twelfths of an inch in diameter of base.

When seen, about 12 hours after the injury, there was not much constitutional disturbance (temperature, 100°; pulse, 98), nor did any arise during the time he was under treatment. During the first few days a small quantity of blood was passed in the urine, but this soon disappeared.

The anterior wound was firmly healed in 20 days, but that in the back discharged a considerable amount of pus, and did not close until the 30th day.

* Aortic aneurism where the sac intrudes into the lung is rare. It was observed in 8 out of 85 cases collected by PEACOCK. A case is reported in the *Lancet*, 1881, ii, 708.

Dr. W. A. HENDERSON'S Report on the Health of Ningpo for the Half-year
ended 30th September 1881.

THE hot season of 1881 has been extremely healthy for such a locality as Ningpo. One death occurred from a non-climatic cause, viz., granular kidney. In June and July the usual malarial fever appeared, but in August and September there was little of it. Diarrhœa also existed throughout these four months, principally, however, in July. Both affections yielded readily to treatment. In connexion with the excellent health of the community, it is interesting to observe the prevalence of sea breezes almost throughout the whole season, and the comparatively low temperature. During the four months the mean maximum was $81^{\circ}.3$, and the minimum $72^{\circ}.7$. As to the sea breezes, in June they were prevalent, in July they yielded to the southerly land wind, and in August and September they became dominant.

To Mr. WALTERS of the Customs, I am indebted for the following

THERMOMETRIC RETURNS.

YEAR AND MONTH.	MEAN.		MEAN, 9 A.M.		MEAN, 3 P.M.	
	Maximum.	Minimum.	Dry Bulb.	Wet Bulb.	Dry Bulb.	Wet Bulb.
1880.	°	°	°	°	°	°
October	72	64	68	64.1	71.8	65.8
November	59.8	46.5	50.9	46.5	58.9	50.2
December	47.7	36.8	41.6	38	47	41
1881.						
January	49	35.2	40.9	36.8	48.5	40.6
February	53.5	42	46.3	42.7	50.9	46.3
March	50.7	39.7	45.3	41.8	50.1	44.4
April	65.2	56	60.2	57.1	64.2	59.6
May	71.8	62.5	66.7	64	70.4	66
June	78.9	71.3	76.3	72.9	78.9	74.4
July	86.6	77.3	84	77	86.2	80.4
August	86.5	78.5	84	79.2	86	79.4
September	79.1	72.2	74.8	72.9	79.9	74

Note.—Rain fell in the four months June, July, August and September, on 36 days.

Dr. MACGOWAN's Report on the Health of Wênchow for the Half-year
ended 30th September 1881.

INASMUCH as the period of residence of foreigners at Wênchow scarcely numbers in the aggregate threescore years and ten, information touching the influence of the climate on their health is of insufficient importance to be placed on record, it is presumable that a degree of discursiveness in this Report will be pardonable.

Reserving for another occasion the subject of medical topography, it will suffice to state that Wênchow is a departmental city containing a population of between 80,000 and 90,000, with tributary districts swelling that number to 500,000. It is situated 15 miles from the sea, on the right bank of the Pungeha or Ou* river, having its source in the mountains which separate the south-western corner of Chêhkiang province, the province of Fukien, near the source of the Tsientang and Min rivers; those mountains and those of the coast forming part of the Nanshan of RICHTHOFEN. The mountains, or hills rather, of the coast presented at no remote period, at their junction with the sea, a series of deep bays, which have become filled up by alluvial deposits forming a dead level to the very basis of the heights which the waters formerly laved, the hills rising abruptly from the valleys, and, where isolated, presenting the appearance of islands. What were once marshes now constitute a chief portion of the province for a great distance inland. This paludal region is begirt, except seaward, with pine-clad mountains, but has been long reclaimed, and is a very fertile rice country.

Owing to its oranographical surroundings, Wênchow has a greater number of rainy days and a greater rainfall than any port in the empire, *malgré* the deforestation, which here, as in the United States, does not seem to have had any hygrometric effect. It has a distinct rainy season, extending from the middle of May to September, and during the other months of the year rainy days are of frequent occurrence; nevertheless, for foreigners it is probably the healthiest portion of China. Its summer heat is mitigated by the rains and sea breezes, the thermometer seldom remaining long in the nineties, and in winter it rarely indicates the freezing point. A Northern invalid who has been over-stimulated by ozone, positive electricity, hydrogen superoxide in the air, or whatever causes peculiarity of climate north of the Yangtze, may here inhale an admirable alternative, while invalids from the South, who require a Northern winter, may here escape the Arctic blasts which in higher latitudes pierce him as if he were gossamer. In fine, Wênchow possesses the climate of Nice without a *mistral*. In summer the tourist may cruise among beautiful islands and fish to his heart's content; in winter he may scale Alpine heights of illimitable extent, not needing to traverse a plain between this and the "Roof of the World;" and if endowed with requisite qualities, become a mighty hunter before the people, who here suffer from ravages by tigers, animals which are as troublesome here as they are under

* 歐 Ou; this is the name formerly applied to the entire region. It is now classical for Wênchow; etymologically, *Tuileries*.

the equator or on the banks of the Amoor. Unfortunately, this port, so attractive to the invalid, is uninviting to patients, because for such there is no suitable accommodation. This is a delightful resort for those only who can "rough it."

An indication of the climate of Wënchow is furnished by its flora. It is the northern limit of the bastard banyan (*Ficus pyrifolia*), but still maintaining its tropical magnificence; and the coir palm (*Chamærops excelsa*), which here attains its highest latitude as an industrial product, meet chestnuts and dwarf oaks of the North; and it is at this overlapping of zones that a peculiar species of orange flourishes, the well-known Wënchow bitter orange, a delicious stomachic, fit to be designated the mild cinchona orange. The bitter principle is contained in the membrane which subdivides the pulp; the pulp itself is sweet.

This hasty glance represents the aspect of the region when in repose; but it is subject to floods from the mountains and cyclones from the ocean, storms that lay waste the fertile fields, and by their destructive agency occasion famine and pestilence. Records of these most violent of physical disturbances are to be found in local gazetteers, and as the phenomena are interesting to meteorology, I subjoin a list which comprises a period of over 15 centuries, and includes the maritime portions of Chêhkiang and part of Fukien. First, however, it is fit to premise a few explanatory remarks on the sources of that information.

Every province, every department, and almost every district in the Empire has a great pile of volumes which are denominated topographies, but as they relate to geography, public works, buildings and temples, physical phenomena, natural history, biography, manners and customs, matters fiscal and military, to annals and the like, "gazetteer" appears a more suitable term, although to some, "miscellanies" may seem preferable. The earlier records of these gazetteers are collated from general history and local traditions. At a later period, when local registers came to be kept at yamêns, these and the ana of scholars and families furnished the matter of which they are composed. It is not often, however, that the public archives are well kept, and the gentry, when they undertake to get up a new edition, are obliged to supplement material from their own records. A century or more will sometimes elapse between editions, and generally it will be found that the new ones have eliminated, as not worth perpetuating, information which foreigners—the statistician, for example—would greatly prize, a fact to be noted in connexion with the subjoined lists. Another explanation is requisite to the right comprehension of the tables. When facts on any subject are derived from a district gazetteer, they will be found more numerous than when they are furnished by the departmental or the provincial volumes. A list of epidemics, for instance, furnished by a district gazetteer will appear more formidable than when a departmental work has been drawn from. If defective, the records are never inaccurate; what are registered as facts were actual occurrences or appearances, although sometimes misinterpreted, as in cases of certain physical phenomena.

RECORD of STORMS, FLOODS, DROUGHTS and FAMINES in the Departments of Chüanchow, Foochow, Wênchow, and Ningpo, situated approximately between latitude N. $24^{\circ} 40'$ and N. $30^{\circ} 02'$, and longitude E. $118^{\circ} 50'$ and E. $121^{\circ} 22'$.

Abbreviations.—S.W., storm wave; Ty., typhoon; St., storm; FL, flood; Fa., famine; Dr., drought; Sp., spring; Su., summer; A., autumn.

A.D.	Moon.	Chüan-chow.	Foochow.	Wênchow.	Ningpo.	A.D.	Moon.	Chüan-chow.	Foochow.	Wênchow.	Ningpo.
291	4	...	...	S.W.	...	1216	...	...	Dr.	...	Dr.
293	6	...	...	St., S.W.	...	1217	...	...	FL	...	...
304	...	...	...	Fa.	...	1217	...	...	Ty.	...	...
480	4	...	...	...	...	1220	...	...	...	...	Dr.
648	8	St., S.W.	...	...	...	1221	...	...	Fa.	...	...
663	7	...	...	S.W.	...	1222	...	...	Dr.	Dr.	...
674	Sp.	...	...	Fa.	...	1224	A.	FL	...	...	...
684	6	...	...	St., S.W.	...	1233	3	...	...	FL	...
689	7	...	...	FL	...	1233	8	...	...	FL	...
768	A.	...	FL	...	...	1240	6	...	Dr.	...	...
783	6	...	...	Dr.	...	1241	...	...	Dr.	...	...
784	8	S.W.	...	...	...	1240	6	...	...	...	...
791	...	...	...	...	Dr.	1246	...	...	FL	...	...
797	4	...	FL	...	...	1248	...	...	FL	...	...
840	...	...	...	...	Fa.	1352	...	...	Dr.	...	...
841	...	...	...	...	...	1295	...	...	Dr.	...	...
984	8	S.W.	...	...	...	1297	...	...	...	Fa.	...
1004	...	...	Ty.	...	...	1278	6	...	...	FL	...
1001	8	...	...	Ty.	...	1279	...	...	Fa.	...	...
1005	8	...	Ty.	...	...	1291	6	...	...	...	...
1029	...	...	FL	...	...	1293	6	Dr.	...	...	...
1066	8	St., FL	...	...	...	1297	7	FL	...	S.W.	...
1067	6	St., S.W.	...	...	...	1308	...	...	...	...	Fa.
1093	A.	...	...	...	Dr., Fa.	1324	...	St.	...	S.W.	Fa.
1094	...	...	...	...	Fa.	1330	...	...	...	...	FL
1101	...	...	Dr.	...	...	1332	...	...	...	...	Fa.
1110	...	...	Dr.	...	...	1333	...	FL	...	...	...
1126	...	...	...	St.	...	1343	A.	...	...	FL	...
1130	A.	...	...	...	...	1344	...	...	...	St.	...
1133	I	...	Fa., FL	...	...	1345	...	...	...	...	Fa.
1134	9-10	...	FL	...	...	1346	S.	...	...	Fa.	...
1135	5	St., FL	FL	...	...	1347	...	...	...	...	Dr.
1149	...	...	...	...	...	1349	...	...	...	St., S.W.	...
1150	...	...	...	Fa.	Fa.	1350	7	...	...	...	...
1152	...	...	...	S.	...	1354	...	3 Tides	...	Fa.	Dr.
1159	...	...	...	S.	...	1356	6	...	St.	...	...
1160	7	...	FL	...	...	1357	...	...	...	S.W.	...
1163	...	...	...	Fa.	...	1363	8	...	...	S.W.	...
1165	...	...	...	Fa.	Fa.	1367	...	St.	...	...	...
1166	8-17	...	...	S.W.	...	1376	7	...	...	S.W.	...
1171	5	...	Dr.	FL	...	1377	...	FL	...	...	...
1171	6	...	...	Dr.	...	1381	6	FL	...	...	...
1174	...	...	...	...	Fa.	1389	...	...	...	Fa., Dr.	...
1178	5	...	FL	...	S.	1399	...	FL	...	...	...
1179	6	...	S.	...	Dr.	1417	...	Fa.	...	...	...
1180	Su.	...	...	FL	...	1426	...	...	...	...	Ty.
1183	...	...	...	...	Dr.	1432	6	...	...	...	Ty.
1185	...	...	...	...	Dr.	1446	5	FL	...	...	Dr., Fa.
1188	...	...	Dr.	...	Dr.	1449	...	...	...	...	Fa.
1189	...	...	FL	...	...	1456	...	Dr.	...	...	...
1192	4	...	FL	...	...	1457	S.	...	...	...	Dr.
1195	A.	...	...	...	Ty.	1459	...	Dr.	...	...	...
1195	A.	...	...	...	Fa.	1467	I	...	...	FL	...
1203	6-7	...	...	...	...	1478	...	...	...	...	...
1205	...	...	Dr.	...	...	1479	...	Fa.	...	...	FL
1210	I	...	FL	...	...	1480	...	...	...	...	S.W.

RECORD of STORMS, FLOODS, DROUGHTS and FAMINES—*continued.*

A.D.	Moon.	Chüan-chow.	Foochow.	Wênchow.	Ningpo.	A.D.	Moon.	Chüan-chow.	Foochow.	Wênchow.	Ningpo.
1481	...	...	...	...	...	1624	A.	...	...	...	Dr.
1483	8	...	St.	...	...	1627	7	...	...	...	FL, Dr.
1486	Sp. to Su.	FL	...	...	...	1628	S.	...	...	...	FL, Fa.
1487	9	...	...	...	Dr.	1628	7	...	...	...	St.
1489	Sp.	Dr.	...	...	...	1633	...	...	...	...	Dr., Fa.
1490	6	...	...	St.	...	1635	...	...	...	...	Dr., Fa.
1491	...	...	...	Fa.	...	1637	6	...	...	...	St., Dr.
1493	...	...	...	...	S.W.	1638	...	...	...	...	St., FL
1494	7	St.	...	...	...	1639	...	...	...	...	Dr., Fa.
1499	4	FL	...	...	...	1640	S.	...	...	...	St.
1500	12	Dr.	...	...	...	1640	8	St.	...	...	...
1502	...	Dr.	...	...	...	1641	...	...	...	...	Fa.
1504	9	FL	...	...	...	1642	...	...	...	...	Dr., Fa.
1505	...	...	...	...	Fa.	1647	...	...	...	...	Dr.
1509	...	...	...	...	Dr., Fa.	1649	8	Fa.	...	...	...
1514	...	...	...	...	Dr., FL	1650	9	St.	...	...	Dr.
1512	...	...	...	...	Dr.	1651	...	...	...	Ty.	...
1513	...	...	...	Fa.	Fa.	1653	A.	...	...	...	Dr.
1514	...	Dr., Fa.	...	...	...	1654	A.	...	...	...	Dr.
1529	8	St.	...	...	...	1656	6	...	...	...	St.
1524	...	...	...	...	St., S.W.	1655	...	...	...	...	Fa.
1525	...	...	...	...	Ty., Fa.	1658	5	...	...	...	St.
1527	...	...	...	Dr., Fa.	Fa.	1660	7	...	Ty.	...	...
1535	8	...	...	...	St.	1662	A.	Ty.	FL	...	...
1536	...	...	Dr., St.	...	...	1664	A.	FL	...	...	...
1538	...	...	...	...	S.W.	1665	6	FL	...	...	...
1540	...	...	...	...	S.W.	1666	...	Dr.	...	...	St.
1542	Sp.	...	...	St.	...	1668	...	...	...	...	Dr., Fa.
1542	A.	...	...	Dr.	...	1669	7	...	...	FL	...
1546	...	Dr., Fa.	...	Fa.	Fa., Dr.	1670	...	Dr.	...	...	...
1548	...	...	...	St.	...	1671	...	Dr.	...	Fa.	...
1555	9	...	...	St.	...	1672	...	...	...	...	Dr.
1558	7-8	...	...	St.	Dr.	1674	8	...	...	FL	...
1562	...	...	...	St.	...	1675	6	...	...	...	FL
1569	7	...	...	St.	...	1676	A.	...	...	...	Dr.
1570	...	...	...	...	FL	1677	4	Fa.	...	...	FL
1575	6	St.	...	St.	...	1679	8	...	...	...	St.
1576	...	...	...	St., Dr.	S.W.	1680	...	Fa.	...	...	...
1579	5	...	FL	...	...	1681	A.	Dr.	...	FL	...
1585	7	...	...	...	FL	1682	...	...	...	Dr.	FL, Dr., Fa.
1586	...	...	...	...	Fa., Dr.	1683	4	...	...	FL	...
1587	6	...	...	...	S.W.	1684	...	...	...	Dr.	...
1589	7	...	...	...	St., Fa.	1686	...	...	...	...	Dr.
1592	8	...	FL	...	...	1688	5	FL	...	...	...
1595	5	St.	...	...	...	1690	...	...	...	S.W.	Dr., Fa.
1597	8	Ty.	Ty.	...	...	1692	...	S.W.	...	...	Dr., Fa.
1599	...	...	...	...	FL	1694	...	...	...	...	Fa.
1601	...	FL, Ty.	...	Ty.	...	1698	...	...	...	...	FL
1602	6	FL	...	...	...	1699	4	St.	...	...	...
1603	9	FL	...	...	...	1700	9	...	...	FL	...
1604	8	Ty.	...	...	...	1702	...	...	...	...	Dr., Fa.
1607	8	Fa.	...	...	...	1704	8	Dr.	...	...	...
1608	5-6	Ty.	...	Dr., St.	...	1707	S.	...	...	Dr.	...
1609	5	...	...	Fa.	Fa.	1711	...	...	...	...	...
1610	5	...	...	FL	FL	1713	...	...	...	FL	...
1612	...	St.	...	...	FL	1714	S.	FL	...	...	...
1614	A.	Dr.	...	Ty., Fa.	...	1718	6	...	...	...	...
1615	S.	3 Tides.	...	...	...	1719	8	FL	...	...	...
1615	A.	...	...	FL	...	1721	5	...	Dr.	...	...
1616	8	FL	...	...	...	1722	...	...	...	...	Dr., Fa.
1617	...	Fa.	...	...	...	1723	6	Ty.	...	...	Dr., F.
1618	...	Fa.	...	...	Dr.	1724	7	...	...	...	Dr.
1620	S.	S.W.	...	...	...	1725	6-7	FL	FL	...	...
1621	6	...	...	...	Dr.	1729	7-8	...	St.	...	FL

RECORD of STORMS, FLOODS, DROUGHTS and FAMINES—*continued.*

A.D.	Moon.	Chüan-chow.	Foochow.	Wênchow.	Ningpo.	A.D.	Moon.	Chüan-chow.	Foochow.	Wênchow.	Ningpo.
1729	A.	Dr.	...	...	Dr.	1809	...	...	...	...	Fa.
1731	7	Fl.	...	...	...	1810	...	...	...	Ty.	...
1734	7	...	...	St.	...	1814	...	...	...	Fl., Dr.	...
1738	9	...	...	Fl.	...	1818	...	...	...	...	S.W.
1739	...	...	...	Dr.	...	1819	3	...	...	St.	...
1741	...	...	...	Dr.	...	1819	6	...	...	St.	...
1745	7	...	...	...	S.W.	1820	6	...	...	St.	Dr.
1747	A.	...	...	...	Dr.	1821	A.	...	...	Ty.	...
1749	...	St.	...	...	...	1823	Sp.	...	...	St.	...
1752	...	...	...	...	Fa.	1832	...	...	...	Dr.	...
1753	...	St.	...	...	Dr.	1834	...	...	...	...	Fa.
1756	8	...	...	...	Fl.	1835	Su.	...	...	Fa., Ty., Dr.	...
1758	...	Fl., Dr., Fa.	...	...	...	1836	6	...	...	Dr., S.W.	...
1759	...	Fl.	...	...	Fl.	1839	7	...	...	Fl.	...
1760	A.	...	...	...	Fl.	1844	8	...	...	St.	St., Fl.
1762	...	Fl.	...	...	...	1847	7	...	...	Ty.	...
1769	6	...	...	...	St.	1848	...	...	...	...	Dr.
1772	A.	...	...	...	Fl.	1849	4	...	...	St.	...
1796	5-6	...	...	Dr.	...	1853	8	...	...	...	St.
1796	8	...	...	Fa.	...	1854	6	...	...	St.	...
1799	...	...	...	...	Dr., Fa.	1856	7	...	...	Ty.	...
1801	6	...	...	Ty.	...	1858	8	...	...	Ty.	...
1805	5	...	...	Ty.	...						

Of the above-named ports, only Chüanchow is situated on the sea, the others being at tide distant.

Wênchow and Ningpo are fuller, because district gazetteers have been consulted, the others being from departmental gazetteers; those, moreover, are of recent date, these are a century and a half old.

By "famine" nothing more in many cases is meant than local dearths, and none are stated to have been attended with cannibalism, but the poor were often driven to child-selling.*

Floods are recorded only when they are remarkable for violence, extent and destructiveness, and present no peculiar appearance, as elsewhere, they overleap barriers, submerge towns, furrow the face of the earth, and destroy crops and life. The suddenness of their rush, particularly when they are the result of waterspouts or pent-up subterranean reservoirs, causes them to be referred to supernatural agency. The gyratory waterspout is considered to be a dragon, and it is likely that it gave rise to belief in such a monster; while water suddenly rushing from the ground is attributed to an embryotic dragon which is formed in an egg, the product of that aerial being and a serpent, the breaking of the egg causing the flood.

By "storm wave" is meant what the records style "overflow of the sea."

The two cases of a "third tide in a day," so designated, are not to be confounded with the periodical bore or egre, but are exceptional phenomena. According to the *Hsing Pau*, that phenomenon was witnessed at Shanghai 28th October 1880. It was neap tide, low water

* Of the 35 famines recorded by WANG FÈNGCHOW (鳳洲綱鑑全編, an abbreviated history), occurring between A.D. 153 and 1640, six were attended by cannibalism, in two of which parents ate their children, and children ate their parents. For an account of *Droughts and Famines in China*, A.D. 620 to 1643, by A. HOSIE, M.A., H.B.M.'s China Consular Service, vide *Journal of the N.-C.B., Royal Asiatic Society*.

at 0.15, a short time before which the supplementary tide appeared. A strong N.E. gale was reported as blowing off the coast on the day previous; the wave may have been due to that cause, but such gales are of common occurrence, while "third tides" are rare. The last, according to the same paper, having taken place in 1851. The earliest of those recorded in the Shanghai gazetteer took place on the 23rd day of the 6th month A.D. 1357, when "towards dawn the sea rose suddenly, causing great alarm, as it was not the time for high water; at the proper high water time it again rose, so that it was known that the first rise was not the tide. In the canal and lakes near Pinchiang and Kiahsing the waters suddenly rose some 4 or 5 feet."* The subsequent occurrence of "third tides," to wit, 1634, 8th month; 1642, 8th month; 1648, 7th month, 21st day; 1661, 7th month, 26th day; 1662, 7th month; 1719, 9th month, 19th day; 1754, 8th month; 1778, 8th month, are given without remark. Occurring as they did during the typhoon season, they may have been storms which, having spent their force, were unobserved, but the cause of some of these oscillations, like the first named, must be sought for elsewhere. Although data are wanting for their co-ordination with earthquakes or submarine volcanic action, it is reasonable to infer that they are co-related, having their source in the volcanic chain which girdles the entire coast of Eastern Asia.†

To submarine volcanic commotion may probably be attributed a phenomenon that was observed in the summer of 1166 on the coast near Wënchow. For three days the sea made a noise and presented the appearance of coagulated milk, in the form of the perforated coin in common use, meaning apparently foaming eddies. It was preceded by a flood emitted by a serpent, which was found to be 10 feet long.

The climatologist who desires to compare the coast with an inland region on the same latitude will find the gazetteer of Chichau full of information. That department is west of and coterminous with Wënchow, and is wholly mountainous, but of no great altitude. Its "calamitous records" for the 352 years following 1511 show:—Storms, 5; floods, 49; famines, 19; droughts, 44.‡

* "Note on Cosmical Phenomena observed in the Neighbourhood of Shanghai during the past 13 Centuries," *Journal of the N.-C.B., Royal Asiatic Society*. Read 23rd December 1858, by D. J. MACGOWAN, M.D.

† Analogous to the abnormal waves that flood the China coast are those which impinge on Tungking:—"Un phénomène surprenant est que quelquefois la marée, après avoir descendu pendant environ trois quarts d'heure, remonte subitement et les canaux qui les autres jours ne sont pas navigables à marée basse, le sont pendant tout le cours de la journée.

"Il y a quelques années sur une des côtes du Tunkin est survenu un événement très extraordinaire. On a entendu un bruit effrayant plus fort que celui que peut produire la plus fort canonnade; et ce bruit a été suivi d'une violente irruption de la mer, qui s'est avancée jusqu'à plus de deux lieues dans l'intérieur des terres, y a porté des arbres déracinés et des débris de bâtiments, et au bout de douze ou quinze heures s'est retirée dans son lit, ayant noyé nombre d'hommes et d'animaux et détruit plusieurs villages. Ce même phénomène avait eu lieu environ cinquante ans auparavant."—*Exposé statistique du Tunkin, de la Cochinchine, du Camboge, du Tsiampa, du Laos, du Lac Tho, sur la relation de M. de la BISSACHÈRE, Missionnaire dans le Tunkin*: Londres, MDCCCXL.

‡ The same record furnishes a singular instance of suspended animation and a restoration by a stroke of lightning. In the year 1650 a child three years of age died and was interred in the garden of his parents near the city of Suichang. "A stroke of thunder" (it is thunder, not lightning, in China, that does harm) "struck the grave, and the boy was restored to life." How long he had been entombed or how the grave was constructed is not stated. It is probable that if all the facts of the case were known, they would confirm Dr. RICHARDSON'S view that when blood does not become pectous, but remains in an aqueous condition, life may be retained to an indefinite period. It is painful to add that the child, so marvellously preserved, was soon after immolated by his father. A malicious neighbour gave out that the boy was, in fact, a "son of thunder," and that the parent was derelict in not reporting the case to the magistrate; whereupon, in terror, the father killed the poor boy.

In the foregoing record the term "storms" often includes typhoons or cyclones the central portions of which passed at a distance.

Disastrous storms and typhoons (only of a disastrous character are included) appear to average 16 in a century.

Chinese coastlanders and mariners are good prognosticators of storms. "When a solar halo, variegated like the rainbow, is visible, the appearance is styled 'typhoon mother'; then dogs and fowls are voiceless, and there is sure to be a spiral or whirlwind." It is a "crazy wind that blows from all quarters in summer and autumn." The Wênchow supplemental gazetteer says there is a grass the joints of which indicate the approach of a typhoon; it is called the "knowing wind grass."*

From the time of YU the Great to the present, China has been heroically struggling to defend herself against constantly recurring disasters of flood; her rivers, notably the Yellow River, "China's sorrow," have tasked the skill of her engineers, and proved a drain to her resources. Has not the time arrived when she may obtain some scientific basis for ascertaining the hydrological and meteorological conditions which are the cause of her chronic ailment? What has been done for investigation of floods of the Mississippi,† which has been the model of Mr. GORDON on the Irrawaddy; measurements prolonged over considerable time, and in varying conditions; systematic investigation of velocity and flood discharge at different points, and the quantity of sediment held in suspension at different depths, are extremely desirable for all those rivers or portions of rivers which are seats of foreign commerce. Systematic observations with the rain gauge and thermometer over as much of the drainage areas as practicable, all having reference to future hydraulic works, and for comparison with observations now making in India and Burmah to discover a connexion or co-existence with phases of flood, drought and famine between that and this portion of the continent. It is still a moot question if there are cycles of famine and drought, and also on what the meteorological conditions depend, and their concurrence with the presence or absence of solar spots and their recurrence in undecennial periods. It would not be difficult, moreover, for the Customs department to pursue investigation of the waters of the rivers and coasts for the elucidation of biological and physical problems connected with the Chinese fisheries.

The meteorological observations which have been carried on for several years by the Imperial Maritime Customs by direction of the Inspector General have put the student of that science in possession of valuable data which in due time will be turned to practical account. Only one thing is wanted in order to render future observations in China as useful as they have recently become in America and Europe. The want in question is simultaneity in observation, in accordance with the request of the International Congress which met at Vienna in September 1879, to wit, "It is desirable with a view to their exchange that at least one uniform observation, of such character as to be suited for the preparation of synoptic charts, be taken and recorded daily and simultaneously at as many stations as are practicable throughout the world." This

* For a meteorological record of observations, for a period of 11 months, see *Customs Medical Reports*, May 1878, by Dr. MYERS.

† HUMPHREY and ABBOT, *Reports on the Mississippi*: Washington, 1861-1879. *Reports on the Irrawaddy*: ROBERT GORDON, Rangoon, 1879, 1880.

request has been almost universally complied with, and now the globe is photographed, as it were, its atmospheric condition being taken at the same moment of actual (not local) time. It is only by simultaneous observations that the actual fluctuations and the cyclonic and anti-cyclonic movements of the aërial ocean can be accurately noted. Père DECHEVRENS, Superintendent of the Sicawei Observatory, informs me that prior to January last he sent to the Chief Signal Officer of the United States army at Washington his observations made at 8.49 local time, corresponding to 7.35 A.M. Washington time, but that a modification of the time for simultaneous observation was requested, and since the 1st January meteorological observations have been taken 35 minutes earlier, or at 8.14 P.M. Sicawei mean time. To that change the International Meteorological Committee appointed by the Congress of Vienna has given its adhesion, and 0.8 P.M. Washington time is the instant for making observations in China, when it is decreed that the Customs shall fall into line. So extensive is the area occupied by Customs observers that their adhesion to the plan of simultaneous international observations, particularly if three daily observations are made, will be hailed with satisfaction by the scientific world, and eventually by the mercantile world as well, inasmuch as mariners are perplexed by observations made in cyclones that do not correspond with the teachings of accepted authorities on the laws of storms. They do not find that the centre of a storm always bears eight points from the direction of the wind, nor that the barometer always falls towards the centre, or always rises on receding from the storm centre. The tracks of storms laid down in charts of the China Sea require further investigation, having been made on insufficient data. A renewed collocation of the meteorological phenomena is a desideratum. Further, it remains to be demonstrated that the whole current of a storm ascends from its centre. In a word, the whole subject of the storms of this coast demands the attention alike of the navigator and the scientist. It is with no satisfaction that I give expression to doubts respecting the rules laid down by REDFIELD, REID, and PIDDINGTON, for in 1853 I published in Chinese a précis of what they had written on the subject.* The brochure was republished in Japan by the Prince of SATSUMA. I would fain recall it for elimination and modification. It may seem chimerical to propose the establishment of a meteorological observatory at each of the Customs stations, but the proposition is alike feasible and desirable, apparatus neither costly nor complicated, such as has been described by Dr. DRAPER, Superintendent of the New York Meteorological Observatory,—no photographic recording barometer being required,—a “dollar clock” forming the most intricate portion of the apparatus.† The average annual expense of American signal stations is about \$300, exclusive of soldiers’ pay and telegraphic messages, but as the observations there made are comprehensive and complicated, a much smaller sum would suffice for Customs meteorological observations.‡ For example, observations made in the interests of agriculture for forecasting the weather, investigations in magnetism, atmospheric electricity, anemometry and actinometry might be dispensed with as being but remotely connected with Customs or mercantile concerns. Investigations on solar radiation and

* 航海金針 寧波 Ningpo: Published at the expense of J. C. BOWRING, Esquire.

† For a description of Dr. DRAPER’s instruments, *vide Scientific American*, Supplement, 3rd January 1880.

‡ General HAZEN’s *Report of the Signal Corps for 1881*: Washington.

the absorption of the sun's heat by the atmosphere would lead to trustworthy predictions of periods of drought and scarcity, and have bearings which affect commerce hardly less than agriculture, and not very indirectly Customs revenue. In conclusion, I beg leave to suggest the adoption of the metric system by Customs observers, seeing that it must ultimately be extended to China.*

If quest be made for average specimens of the Chinese race, this beautiful, fertile, and densely-peopled region will not furnish examples, the inhabitants comparing disadvantageously with those of adjacent portions of the Empire, being physically and intellectually inferior. They are of delicate frame, insignificant physiognomy, and microcephalic—small-brained. Fewer attain to 70 years of age here than in coterminous departments, and, as in southern Chêhkiang generally, it is seldom that scholars succeed at the provincial examinations. They are simple, friendly, and law-abiding, but are charged by their countrymen as being particularly salacious. They are greatly addicted to temple attendance, and are evidently deteriorated descendants of a devout race; nowhere are temples and pagodas, monasteries and nunneries, so numerous. The religious orders are credited with contributing greatly to the perpetuation and dissemination of a contagious disorder, which accounts for their inferior physique; and as they are now largely addicted to the use of opium, there is little prospect of physical melioration.

Situated as it is on a reclaimed marsh reticulated by canals, and almost on a level with its sluggish waters, Wênchow cannot but be the abode of intermittent fever. Every spring, to some extent, and in autumn that disease prevails, affecting betimes half of the inhabitants of a village. It appears in protean form, but generally of mild type, except to new-comers, who, after acclimatisation, do not regard it with dread. Labourers and other impoverished people who cannot afford to purchase medicines lie down on the ground when seized by a fit, and after the paroxysm is over revert to their toil, and so they live until in the course of years the poison ceases to affect them; but the anæmia and debility that ensue render them an easy prey to other maladies, and they are not long-lived. Quotidian and tertian are light and transient, amenable to treatment, and disappearing on the advent of cool weather. Tertians, which are the prevailing form, assume sometimes the quartan type, becoming chronic and incurable, continuous for a year or two and then terminating fatally.

At first sight the prevalence of ague at the close of summer and in early autumn might seem due to the condition of the rice-fields. The early and the late rice are planted in May at the same time, side by side in alternate plots. The former, ripening in August, is then harvested, the latter then having attained but half its growth. A moiety of the still submerged soil being no longer shaded, is exposed to the fierce solar rays, and soon after agues begin to appear. We may not therefore conclude, however, that the poison has its genesis in rice-fields, inasmuch as those most competent to judge, the inhabitants, exonerate their fields

* Of more importance than thermometrical and barometrical observations in Formosa would be a seismological record—earthquakes in that island being about as frequent as in Japan or Luzon—its seismic area including the coast.

Valuable information on the migration of birds was recently obtained from lighthouses on the east coast of Scotland in compliance with the printed forms that were addressed to them by Messrs. BROWN and CORDAUX. As on the American coast it is found on the European, that birds dash themselves against lighthouses; might not the *phares* of this coast be utilised in this manner?

from any agency in the matter. The question must be considered *sub judice*. From time immemorial Chinese physicians have been aware of the value of arsenic in the treatment of ague, but they refrain from administering it internally, their pharmaceutical knowledge not enabling them to prepare it in doses sufficiently attenuated to be unattended with danger.

Perhaps no country has suffered more from epidemic diseases than China, and certainly there is no country whose annals contain such a continuous record of calamities of that nature, consisting mainly of notices of enteric fevers, observations on which come down from proto-historic times. More than a score of centuries before HIPPOCRATES wrote of "critical days," HWANGTI, the "Yellow Emperor," is represented as referring to the same subject,—crises in disease and the natural tendency which the body has to cure itself by critical evacuations at certain periods,—in a conversation on physiology and pathology which he held with C'HIPE, his physician and minister; and since the dawn of authorship there has been a succession of medical writers, but no caste existed to hand down the earliest observations—no Asclepiades to record the cures, nor healing temples, or material for evolving an HIPPOCRATES; yet the preserved works display great acumen and powers of observation, and the careful perusal of Chinese medical works must elicit many interesting, if not valuable, facts, but that is not now feasible. In the meantime fragmentary contributions to Chinese medical history will not be unacceptable. A work that is in the hands of every practitioner, entitled *Essay on Epidemics*, discloses the curious fact that, according to the author, physicians in China had for 1,400 years proceeded in the treatment of epidemic fevers on a wrong course, which caused frightful loss of life during all that period. The work is from the pen of WU YUHSIN (吳有性 瘟疫論), a physician of Soochow, who wrote his book in 1641, but it circulated in manuscript form only until 1508, when some public-spirited scholars contributed for its publication. The edition before me appeared in 1852.*

According to Dr. WU, erroneous views respecting the etiology of fever prevailed from the period of the TSIN (265 A.D.) down to his day. The profession had fallen into the mistake of regarding epidemic fever as caused by, like ordinary continuous fever, vicissitudes of the seasons, instead of ascribing them to a specific poison (厲氣). At the period of his writing, the provinces of Chêhkiang, Kiangsu, Shantung, and Chihli suffered from a fearful epidemic, but he affirms that the mortality was not due to the pestilence, but to the wrong treatment to which the unfortunate patients were subjected. "Morbific cold" (傷寒) is a generic term for fever, perhaps best expressed by *Febris synocha*. The cold of winter engenders the miasm, which enters the pores of the skin; it is non-contagious, and prevails every year,† while the poison of epidemic fevers is taken in at the mouth and nostrils, and is communicable. In the former, sudorifics are indicated, in the latter, discutients. With the exception of this great medical reformer, there has been no writer on epidemics that I can discover, after searching various catalogues. No one can write the medical history of China without reading Dr. WU on "epidemics." There is one paragraph in his work which I translate for the benefit of those

* [Dates as in MS.]

† The earliest known work on fever is the 傷寒論 by 漢張機, who may have flourished any time between B.C. 200 and A.D. 200. He has had numerous successors.

foreign residents in China who may be unaware of the perils of out-door exercise on an empty stomach—a matter that does not seem to have attracted the attention of physicians until modern times. This cotemporary of the illustrious HARVEY says, of three men encountering morning malaria, one whose stomach is empty will sicken and die, the other who has imbibed spirits will suffer a disease, while the third, who has well breakfasted, escapes unscathed.*

Subjoined is a list of epidemics that have ravaged this province during the ages that have intervened since the recording of such phenomena commenced. It is from the provincial gazetteer, and from those of a majority of the departments and from several districts; so far as it goes it is accurate, but, as already remarked, those publications present innumerable lacunæ.

RECORD of EPIDEMICS in the PROVINCE of CHÊHKIANG.

A.D.	Moon.	—	A.D.	Moon.	—
95	4	Hsianhsing districts.	1333	3	Preceded by a flood.
758	...	Preceded by drought and flood.	1334	...	Western part; preceded by drought and famine.
783	...	Preceded by drought and flood.	1361	Summer	Shaohsing, two districts.
791	Autumn	Western part of the province; preceded by drought.	1363	...	Shaohsing, two districts.
806	Summer	Eastern part of the province.	1385	...	
829	Spring	Western part of the province.	1403	7	Shaohsing, two districts.
833	Summer	Hangchow and west.	1414	7	Throughout Hangchow, Hsianhsing and Ningpo.
870	...	The entire province.	1417	5	Kinhua; epidemic, leprosy.
1001	...	Entire province.	1435	Winter	Hsianhsing, Ningpo and Taichow.
1195	...	Hsianhsing; preceded by famine.	1443	...	
1131	6	Hsianhsing and western part of province; preceded by famine.	1446	3	Ningpo and Taichow; preceded by drought.
1144	...	Hangchow.	1463	...	Hsianhsing.
1147	Autumn	Hangchow.	1480-1	...	Hsianhsing; for 2 years.
1165	...	Linan and Yuyow; preceded by famine.	1493	...	Kiahsing; preceded by floods.
1173	Sum., Aut.	Hangchow.	1510	...	Huchow; preceded by floods.
1182	4	Hangchow and Linan.	1511	...	Huchow; preceded by floods.
1188	Spring	Hangchow.	1512	Spr., Sum.	Pingwu. Reappeared next year.
1194	6	Western part.	1513	...	
1195	3	Linan, Hsianhsing; preceded by famine.	1516	5	Wênchow.
1196	5	Hangchow.	1526	Summer	Yuyow and Hsianhsing; preceded by drought.
1197	3	Hangchow.	1546	"	Wênchow; preceded by drought.
1199	Summer	Linan.	1547	...	Kiahsing; preceded by drought.
1204	5	Hangchow.	1589	...	Epidemic leprosy over several districts, preceded by unprecedented rains.
1208	...	Yuyow; preceded by drought.	1589	...	Chichau; preceded by floods and famine.
1210	Summer	Linan.	1590	...	Hsiaoshan, a district of Hsianhsing; epidemic leprosy, its reappearance.
1211	"	Hangchow.	1591	...	Epidemic leprosy in Changhua district, Hangchow.
1212	2	Hangchow.	1622	...	Ningpo.
1275	4	Hangchow.	1624	Summer	Ningpo; preceded by drought and famine.
1284	7	Hsianhsing.	1628	...	Ningpo.
1304	Spring	Hsianhsing, Ningpo and Taichow.	1634	...	Chichow.
1305	7	Hsianhsing; preceded by famine.			
1308	7	Hangchow, Yuyow and Ningpo; preceded by drought and famine.			

* Dr. WU quotes from the *Shanghan* (HAN period) certain interesting etymological facts, which show how some characters have been built up, the examples all relating to the healing art. This, for example, is the genesis of 瘟疫. Fever was originally written 瘟病, abnormal heat disease. Subsequently the 疒 was dropt and 疒 substituted, forming the present character. In like manner 疫 was formerly written 徭役, persons pressed into temporary service as menials of Government offices (villein socage), because epidemics also penetrated everywhere, affecting every house alike; but subsequently 役 was placed under, 疒 minus the radical, being used as a phonetic 疫. Lexicographers, therefore, are slightly at fault in describing the latter character as composed of disease and a javelin; it is made up of disease and socage abbreviated.

RECORD of EPIDEMICS in the PROVINCE of CHÊHKIANG—*continued*.

A.D.	Moon.	—	A.D.	Moon.	—
1641	6	Hangchow, and year succeeding.	1718	6	Siangshan.
1652	Autumn	Ningpo.	1757	...	Pinghu.
1660	Sum. & Aut.	Wênchow.	1806	...	Wênchow; small-pox.
1673	Sum. & Aut.	Siangshan.	1811	...	Ningpo; small-pox.
1678	...	Lishui.	1820	Autumn	Wênchow and Ningpo; Asiatic cholera.
1680	...	Pinghu.	1821	...	Wênchow and Ningpo.
1681	...	Ningpo.	1834	Autumn	Ningpo.
1710	...	Siangshan.	1835	Spr., Aut.	" with dearth.
1715	...	Taichow, preceded by famine.	1864	8, 9	Ningpo.

The above is a bald but not untrustworthy record. With few exceptions, the epidemics were probably of an enteric character, but as the term by which they are designated means "diseases which affect everyone at the same time," the list comprehends numerous maladies. It relates to epidemics of a single province. Generally the epidemics named were sequels of droughts, floods, famines or civil war.

With regard to epidemics in Chêhkiang, it may be remarked they were of more frequent occurrence in the maritime regions of the province than in the hilly portions. Many of them seem to have had a limited area.

The mode of transmission of the *materies morbi* is given in only one case. In 1638 an epidemic was conveyed from Hangchow to Tungyang by female children who—a pestilence raging there—were deprived of relatives, and purchased for sale at the neighbouring city; the germ was therefore not air-borne but brought in clothes. In the toxicological chapter of the *Péntsao*, old clothes are included as poisons.

The utility of naming the particular form of an epidemic seems to have occurred to recent compilers of gazetteers, for they mention small-pox and Asiatic cholera. The same thought happily occurred to a few of their remote predecessors, and thus an interesting fact has been transmitted—the existence of an epidemic form of leprosy. It is on record that in the year 1417, in the department of Kinhua, on the Chientang river, an epidemic of leprosy (癘風) prevailed, and also that the same malady sprang up in 1589 in the department of Shaohsing, and that the greater portion of its districts suffered, and, again, that it prevailed during the following year in Changhwa, a district in the coterminous department of Hangchow.

Concerning the contagion as it appeared early in the fourteenth century nothing is reported; that of 1558 and following year sprang up after a period of protracted and unexampled rains,—an autumn and winter rainfall extending through more than three months. During the year that this disease prevailed in the northern part of the province, there was an epidemic at Chüchau, it appears by reference to the foregoing list, and after heavy rains, but of its nature there is no record. This sudden and apparently unprecedented outbreak of an epidemic contagious form of leprosy is remarkable from the fact that the disease is seldom met with in Chêhkiang, and never, perhaps, in the northern part of the province. Fukien to the south, and yet more in Canton, further south, are the seats of that loathsome and hideous malady. Shaohsing is remarkable, however, for the prevalence of elephantiasis of the leg; perhaps there

is no part of the world which suffers to like extent from that disease—due probably, with other causes, to its low situation, being elevated but a yard or so above tide water. It appears to be the epidemic form of leprosy that SHEN LANGCHUNG describes (沈朗仲 病機彙論). The skin becomes scaly and dies; boils and ugly ulcers appear in the flesh, engendering worms; the cartilage of the nose inflames and falls off, as do also the finger-nails; the perspiration has a fishy stench; the hair and eyebrows disappear, the vision fails, and the voice becomes husky and inaudible. Therapeutic measures are futile except in mild cases. I expect to be able ere long to extend the inquiry to the Empire at large, for the purpose partly of examining the ground on which, as alleged, the “black death” of the middle ages originated in China—a besom of destruction which swept from the East over Europe to the shores of the Atlantic.

It is in local, not in general, works that full information is to be found; the search therefore involves considerable toil.* All that the abbreviated history of WANG FICHOU (鳳洲 綱鑑) records on the subject is soon told, and it is subjoined as a contribution towards the general subject. Epidemics are named in the foregoing work as having occurred in the years of our Lord 52, 1054, 1275, 1279, 1308, 1313, 1564, 1583, 1589, 1642, and 1644, when the history comes to a close.

Wenchow has had its full share of cholera ravages, the study of which at this date affords no information to the pathologist, but as a history of that epidemic in China is a desideratum, I submit the following contribution, first reminding the reader that epidemiologists in India are not in accord concerning the origin of cholera, very high authorities affirming that it is purely of Indian origin, and that it originated in the Gangetic Delta in 1813, while other not less eminent authorities find evidence of its anterior prevalence in other parts of the East, citing in support thereof Sanskrit, Greek and Arabian authors, showing that after periods of quiescence it reappears—at intervals sometimes of a century or more. But what is of more moment, these opposing etiological views, which prevail not in India only, but in Europe and America, indicate diverse measures for averting the disease and for limiting the area of its ravages, a contagious malady obviously demanding to be met by different sanitary, if not different remedial, management than a non-contagious disease. Some hold that “all the phenomena are explained by contagion communicated from person to person by a germ from the excreta of cholera patients, that water is the channel through which cholera poison is generally conveyed. Others find in local influences full explanation of the phenomena, holding that the disease is not communicable from person to person, that the poison is air-borne, travelling in obedience to certain fixed laws, and affected by atmospheric and telluric conditions, and, when finding a fit nidus, there developing the epidemic, and that there is no enteric or specific poison in water to produce it, although they insist on purity of water and sanatory regulations generally.”

The voluminous medical literature of China and the records of remarkable occurrences found in gazetteers might be expected to throw much light on these controverted subjects, particularly on the first or historical question, but the result of my investigations thus far afford

* As chapters on an 祥異 that are found in *hsien* and *fu* gazetteers are more to be desired and more difficult to obtain, I beg assistance—that is, the copying out of those chapters; due acknowledgment shall be made for aid in that or any other form.

only a slender contribution to the moot points,—nothing that can be considered approximately decisive,—albeit I must confess that hitherto my inquiries have been restricted to a small portion of this almost boundless field of research. The Malacca Chinese were the first to suffer from Asiatic or Indian cholera, the epidemic having reached the Straits in 1819 by way, it is believed, of Siam. In May or June of the year following it appeared in Wënchow, and about the same time at Ningpo. A septuagenarian who remembers its ravages gives a ghastly account of the city as it then appeared,—a narrative which tradition confirms, and corroborated by written and oral accounts of its first appearance at Ningpo. It then obtained the name by which it is now popularly known here, the “crab-claw disease.” Attacks of the disease were so sudden and fatal that people were stricken down and died in the streets. The “symptoms,” to employ the expression of a French pathologist, “commenced with death.” There is but one account of this form of cholera that I can hear of; it is a monograph, the work of a physician of the city of Chiahsing. That writer says that the disease first appeared in Kiahsing (on the borders of Chëhkiang and Kiangsu) in 1821, and was regarded as *sui generis*, and received the designation of “contracting of the tendons of the leg” disease (脚筋吊 吊脚痧), which physicians treated as ordinary cholera, the “sudden vomiting and purging” disease (霍亂), and as a consequence they did not save one patient in a hundred. Ordinary cholera is ascribed to “accumulated heat,” which requires a cooling regimen. Our author regarded it as the result of accumulated cold, which, like excess of heat, disturbs the harmony naturally subsisting between the dual powers of the system, and accordingly prescribed warming remedies, a mode of combating the enemy which of necessity became universal. The disease again prevailed in the two years following with unabated virulence, and since that period it has been of frequent occurrence throughout the Empire, notably in Chëhkiang in 1860.* Scarcely a summer passes without the occurrence of numerous marked cases of this migratory contagion appearing in one part of the country or another;† it is now recognised as endemic. In this part of China, what has been styled “dry cholera” is common in hot weather, and is called *sha* (痧), a term that includes colic, sunstroke, heat apoplexy and various disorders that make their attack suddenly. At Canton it is more frequent than elsewhere; the Cantonese affirm that *sha* has prevailed among them from time immemorial, which may explain their belief that they have always had Asiatic cholera among them. It may be regarded now as endemic in this part of China as well, making its appearance even in winter. During the past winter various villages on the Pootung side of Shanghai district suffered from Indian cholera; the only difference which the epidemic

* According to CLEYER (*Cholera Epidemic of 1873 in the United States*), “cholera appeared in China in 1669, coming probably from Malacca,” and GENTIL, in his *Voyage aux Indes Orientales*, states that it prevailed in China soon after its appearance in Coromandel in 1769. These authorities are quoted by Dr. D. B. SIMMONS in his elaborate article on “Cholera Epidemics in Japan” (*I.M. Customs Medical Reports*, September 1879). What sources of information those writers possessed does not appear. I know not what degree of importance should be attached to their statements. Besides Dr. SIMMONS, the subject has been discussed by Dr. JOHN DUDGEON in the *Customs Medical Reports* for September 1872. Unfortunately, I am at present unable to consult that paper, which doubtless contains information that I might have turned to good account. Dr. PATRICK MANSON devotes several pages to Asiatic cholera in China in the *Customs Medical Reports* for September 1877. The September number of the *Chinese Repository* for 1843 contains a paper on cholera at Ningpo, and the August number 1851 has also a few paragraphs from myself on the same subject.

† The latest cholera visitation at this port is recorded in Mr. Commissioner MACKAY’S Wënchow Trade Report for 1878. It prevailed during August and September of that year, and was extremely virulent.

presented from the summer form appearing to be that it was less rapidly fatal, the disease continuing three days before its fatal termination.* The reason assigned by the Chinese for this untimely visitation was that, owing to a protracted drought, the canal waters had become polluted. (While, however, the natives attribute epidemics to droughts, they also say that a protracted and excessive rainfall is often followed by an epidemic. With regard to fever and ague and the weather, they affirm that disease prevails chiefly when a season is unusually windy.) Undoubtedly Indian cholera was regarded in the north of China as a new disease, but it is quite possible, nevertheless, that it was only a reappearance after a period of quiescence, and some of the epidemics named in the subjoined record may have been epidemic cholera. We know that the register of epidemics in recent works includes the cholera visitations. A reference to a medical treatise which is more in circulation than any other† names contraction of the tendons as an occasional symptom in ordinary endemic cholera, but Dr. WU states that while there is a resemblance they are nevertheless distinct diseases. He might have adduced in evidence that while no one regards the "sudden vomiting and purging disease" as communicable from person to person, the new disease is regarded as contagious—a thing, however, held by many as true of fever and ague. The sum of the information that I have been able to gather tends to show that Indian or epidemic cholera is new to China, and that it is not due to an enteric poison communicable from person to person, but to air-borne germs; that it is influenced by atmospheric and telluric conditions, and, consequently, that quarantine regulations to ward off invasion from the migratory foe are futile—a conclusion diametrically opposed to the opinions of Drs. SIMMONS and MANSON, opinions formed by painstaking observers after recent inquiries on cholera visitations in Japan and China. No measures that I can hear of have ever been taken by Chinese authorities of the nature of quarantine to ward off infection.‡ Dr. SIMMONS incidentally alludes, *loc. cit.*, to an epidemic of measles immediately preceding one of cholera, those affected by the former being attacked before recovery by the latter, which reminds me of what I wrote in 1851 on the same subject. "During the autumn of 1848 (when cholera was somewhat prevalent), rubeola prevailed epidemically at Ningpo; it did not assume a malignant form, nevertheless fatal cases were not rare. The epidemic prevailed in the maritime districts of the east coast of China and through the entire Pacific coast till it reached the Samoyedes, among whom it was particularly fatal. A Russian captain reported: 'we had throughout all our colonies the measles, and great numbers of the inhabitants were taken off. Some of our islands in the Aleutian chain lost most of their population. In Sitka, amongst a population of 600, we had in one month 80 deaths, if not more; nearly all, except the Europeans, were sick, so that all the town was in sorrow from fear and dread.' The islands of the Pacific suffered from the same disease (all Micronesia), and at the Sandwich Islands it was very destructive amongst the aboriginal inhabitants. In China it affected both natives and foreigners. It is remarkable that whilst rubeola was traversing this region of the earth from the Tropic of Cancer to the Frigid Zone, cholera was pursuing a western course from the Volga to the Mississippi."§

* 申報, 19th February 1881.

† 醫宗必讀, A.D. 1637.

‡ Articles on cholera are contained in the *Customs Medical Reports* from Dr. DUNGEON.

§ *Chinese Repository*, August 1851.

Perhaps Dr. SIMMONS may obtain information respecting the surging of this wave of rubeola in the islands of the Rising Sun.

Besides the epidemic above named as occurring last winter and spring at Shanghai, there appeared concurrently epidemics of measles and small-pox, the former in the coterminous department of Soochow, the latter at Nanchang, in the neighbouring province of Kiangsi. "Everywhere throughout the Soochow region children were attacked by measles, not of the ordinary mild form, but of a virulent type—nine cases out of every ten presenting dangerous symptoms." The reason assigned for the unusual severity of the disease was the drought of the winter, followed by a rainy, snowy spring. The small-pox at Nanchang was characterised by symptoms of extreme violence at the early stage, and of their sudden subsidence, leaving the disease to pursue a quiet course to convalescence.* Throngs of grateful parents presented thanks at the shrine of the small-pox god for the recovery of their children. The synchronous prevalence of cholera, small-pox and measles in places almost contiguous is a noteworthy epidemiological phenomenon. As a contribution to the epidemiology of China, I subjoin a list of epidemics which have devastated this province, the most disastrous only being chronicled—probably but half the number that have prevailed, as I have before me only five gazetteers out of the 11 which comprehend the province.

In default of narratives from books on the subject of epidemics, an account chiselled on a mural monument in the "Temple of the Five Supernals" (五靈廟), demons of pestilence of this city, will perhaps make amends for their meagreness. It appears from that record that for several tens of years preceding, Wënchow suffered every spring and summer from a contagious malady, the mere symptoms of which caused the patient to be shunned by his nearest relations, who sent them to vacant temples, supplying them there with cold victuals. No one ventured out by night lest a pestilential demon might be encountered, and great distress consequently prevailed. In the year 1579 a magistrate took up the matter, summoning men of age and experience to counsel him. Some of these suggested the free distribution of medicines, others the interment of the unburied dead, and others a grand demonstration to propitiate the five demons which caused the malady, by which they might be exorcised and retire to the river bank. The magistrate took a more comprehensive view of the needs of the situation. Favouring sumptuary and spiritual measures to combat the evil, he read the people a homily—first, on the five cardinal relations (that between Emperor and people, that between father and son, the conjugal and fraternal relations and that between friends); secondly, on the five elements (water, fire, wood, metal and earth); thirdly, on the five flavours (salt, bitter, sour, acid and sweet); fourthly, on the five viscera (the heart, liver, stomach, lungs and kidneys); and fifthly, on the five (?) passions (joy, anger, grief, fear, love, hatred, desire). The gist of this quincuncial discourse was in its application—a reformation in manners, food, and in life generally, was what he considered as requisite for sanatory improvement. All those measures, at least those proposed by the elders, were adopted, and, in addition, the erection of a special temple to the five demons of epidemics was decided on (hitherto those supernals were merely honoured by shrines in various temples). With such zeal was the plan of a temple acted on that it was run up in a month, and a substantial structure it is. Magistrates gave the fines of their courts, the rich gave of their

* 申報, 12th February 1881.

hoards, and the people contributed free labour to the undertaking, endowing the temple with land to defray the expense of incense for ever. It is gratifying to read that the worthy magistrate was able to felicitate himself on the disappearance of the plague.

At the risk of being tedious, I add a paragraph respecting the demons of plague, belief in whom controls official as well as popular action when disease of any kind is rife. In the sixth year of KAUTSU (A.D. 591) reports of an apparition in the sky reached the Emperor; it consisted of "five mighty ones" (五力士). His Majesty consulted his minister, inquiring whether the appearance of the gods was a calamitous or felicitous omen, and received in reply the information that the "mighty ones" were Heaven-sent demons, agents of the five epidemics, to wit, those of spring, summer, autumn, winter and pestilences in general; the minister gave also the names and surnames of the demons as if they were those of characters once known among men. They were robed respectively in green, white, red, black and yellow; each held a utensil, hammer, ladle, sword, etc. "What," inquired the Emperor, "can be done to avert calamity?" "Nothing," was the response; "it is Heaven-sent, and there is no resource." That year a great epidemic scourged the entire nation. On the 27th of the 6th month the Emperor ordered the erection of a temple and sacrifices to be made to the demons, on each of whom he conferred the military title of general. During that dynasty, the SUI, and that of the TANG, temples were dedicated to ceremonies for averting the pestilential wrath of these "mighty ones," now styled "supernaturals."

In wealthy cities—Ningpo, for example,—the demons of epidemics are borne in processions of an imposing character, every guild and precinct contributing to render them magnificent, one feature of which is the appearance on a car of young girls, who seem to form portions of lotus-flowers, being sustained in the air by iron rods dexterously passing through a trouser leg, imparting a fairy-like aspect to the pageant. Occurring as this festival does in hot weather, its observance itself is often a source of sudden disease.

In this city, devotees who take part in processions that are designed to ward off pestilences subject themselves to painful proofs of their earnest zeal. They march for many weary miles with vases of burning incense suspended by hooks from the flesh of their arms, their arms being sustained in a horizontal position by a rod extending obliquely from the hip to the hand. According to the latest local gazetteer, worship at the Temple of the Demons of Pestilence does not now suffice to ward off the diseases to which the city is described as being particularly exposed, owing to atmospheric vicissitudes, albeit it is the most cleanly city in the Empire.

It is due to the school of CONFUCIUS to state that many of its disciples endeavour to dissuade the populace from the degrading feticism into which they are plunged, particularly in matters of hygiene. Such is the statesman who recently acted as governor of Kiangsu; he shut up monasteries, turned the monks adrift, and secularised their ill-gotten property. Such also was CHANG TzŪCHI, a Minister of State under the southern SUNG, who whilom was magistrate of Changchau, in Kiangsu. In the year 1295 an epidemic ravished the city, nine houses in every ten suffering from the scourge. In vain he strove to mitigate and check the malady by establishing a dispensary and furnishing medicines gratuitously. No one applied for relief; all

who needed help for themselves or friends repaired to the Temple of the Demons of Pestilence, where sacerdotal exorcists sold charms and amulets and employed imposing incantations as the sole means proper for averting or curing the prevailing epidemic, and who deprecated the use of medicines; on hearing which the magistrate himself visited the temple, and seeing a row of images of hideous aspect on either side of a grim-visaged central monster, and witnessing the fanatical mummeries by which the multitude were deluded, he ordered the arrest and imprisonment of all concerned; then, providing fortifying viands and stimulating potations to his soldiers, to proceed forthwith to smash the images and to level the temple with the ground, a work which the military accomplished before they became well sobered and capable of understanding the sacrilegious character of their mission. Meanwhile the magistrate ordered the flagellation of the monks, and sent them back into the world. While the townspeople were all wondering what form of judgment the outraged gods would inflict on the daring iconoclast, the Emperor summoned him to a secretariat in the Civil Board at the capital (吏部郎中). Unfortunately, rulers of that stamp have neither imitators nor successors. Naturally, the medical profession is arrayed against the impostures of the priesthood, yet they recognise the need of supernatural aid for success in their vocation, and, in concert with the general public, invoke the assistance of departed practitioners of the healing art, several of whom have been canonised; and hence temples to the *Yo wang*, or Princes of Medicine, are everywhere to be found, being styled by foreigners temples of the "Æsculapius of China," although in all Chinese history there is no personage bearing the characteristics of the reputed son of Apollo. "Medicine Prince" is a title of several medical notabilities, none of whom were regular practitioners nor writers, but successful charlatans rather, one of them being a foreign adventurer. The earliest of those to whom temples of medicine were erected was PIEN CH'IAO, who flourished in the reign of WE LIH (B.C. 468-440). He was a native of the Ching state (Kaifung-fu), but his family belonged to the state of Lu, for which reason he was styled the Lu physician (扁鵲秦越人盧醫). Originally he kept a hostelry, but having met a spirit who induced him to take a certain medicine daily for a month, on the assurance that by doing so he would become spiritualised, the effect of which was that he was able to see through a stone wall, and consequently by his vision penetrate the human system and observe the viscera. Thus he became an adept in diagnosis, and the most obscure disorders gave way to his therapeutic skill. The Prince of Tsin, TING KUNG, had for prime minister a man of boundless wealth who, in the 11th year of TING KUNG, suffered from an illness that baffled the skill of the court physician, and the Doctor of Lu was sent for. He found that the patient had been unconscious for five days, but in less than three days consciousness was restored by the medicines which PIEN CH'IAO administered. The patient recovered and rewarded the doctor by a gift of 20,000 *mow* of land. The distinction thus attained he did not live to enjoy, for the court physician procured his assassination. PIEN CH'IAO is credited with anatomical knowledge obtained by dissection, and with the theory of the pulse, which, like a work attributed to him on acupuncture and the use of moxa (扁鵲神應針灸玉龍經), may be taken as apocryphal. Certain it is that that work, according to the catalogue *raisonné* of the Imperial Library, was composed during the Yuan period.*

* The authorities quoted in MAYERS' *Manual* err greatly as regards the period when PIEN CH'IAO lived and the place of his birth, that is, assuming the correctness of the 鳳洲綱鑑.

In 738 there appeared in the capital a singularly attired foreigner; he wore a velvety robe and a gauze cap; he was peculiarly shod, and bore a staff; attached to his girdle were calabashes, several tens in number, containing medicines, which he freely distributed to the ailing. His fame reached the palace, and the Emperor sent for the foreigner, who announced himself as an "obtained doctrine" (*teh-tao*) man from India. His Majesty was so gratified with him that he ordered his portrait to be taken, and conferred on him the title of Medicine Prince. His name was WEIKU. A Fukien miscellany (閩雜記) names a Medicine Prince Temple or Temple of PIEN CH'IAO, also called Temple of Dr. LU. Another says that the medicine prince, or *pusa*, was WEIKU, who came from Sumatra. Probably he had made himself famous in that island after quitting India before coming to China. He is described as having *teh-tao*, the Buddhist term for one who has entered Nirvana. He was not a Buddhist, however, yet a man of lofty religious character, but whether Brahmin or Mussulman does not appear. When the usurping Empress WU, in the latter part of the 7th century, swayed the black-haired race, a Taoist practitioner of medicine named WEI SHENCHÜN became very celebrated by his austerities as a monk and by the cures that he effected. He was constantly attended by a black dog called "Black Dragon," and obtained by popular acclamation the title of medicine prince, or king. In pictures and images of the canonised doctor, his familiar the black dog is also represented, reminding one of the canine familiar of Western classical and mediæval times. Tradition has it that SIMON MAGUS and other ancient practitioners of the black art and charlatanry in general were attended by black dogs. CORNELIUS AGRIPPA, the famous practitioner and philosopher of the 16th century, had a familiar, what HUDIBRAS calls a "Stygian pug," the doctor's "tutor and cur which read to the occult philosopher." The idea never seems to have taken root in China. WEI SHENCHÜN would probably have been soon forgotten but for the circumstance that a great Minister of State under the SUNG sway had during a severe illness a vision of WEI SHENCHÜN, who was attended with a black dog, as when in the flesh. The spirit directed the boy to swallow a pill, which he did, when a flow of perspiration followed, and the patient was quickly convalescent. The child, when he came to be a ruler, caused a picture of that prince of medicine to be taken, to which he sacrificed, and thus WEI CHÜN again became famous. Soochow boasts a medical pantheon. Formerly the edifice was consecrated to the three Emperors FU HI, SHEN MING, and HWANG, semi-mythic rulers. Subsequently the image of YU the Great was added, all four being honoured for their medical knowledge, and in 1692 a prefect ordered the effigies of K' I PEH, LUI KUNG, PEH KAU, KWEI YUCHÜ, HSIAO YÜ, and HSIAO, and changed the name to the one which it now bears, "Temple of the Healing Kings."* Thus it is clear that these temples cannot be considered as consecrated to a Chinese Æsculapius.

According to the teaching of alchemy, hartall—arsenic bisulphide—is prophylactic against malarious and demoniacal influences. Infinitesimal doses of which are taken with cinnabar in a little liquor on the 5th day of the 5th moon—Dragon festival; in the case of children the powder is smeared on the forehead.

Epidemic frenzies come under the consideration of the physiologist, and demand his attention as a branch of what is termed State medicine, information on which cannot but be

*The greater portion of the above is culled from numerous authors cited in the 集說詮真續編 黃伯祿斐默氏: Shanghai, 1860.

useful to administrators of public affairs. I submit a few paragraphs on the subject, which, if valueless to professional readers, will be found not devoid of interest to laymen. In 1876 there appeared a monograph entitled *Précis of Anthelmintics* (治蟲撮要), an anonymous work by a benevolent, public-spirited gentleman of Changchau, Kiangsi. It was called forth by an event which must be fresh in the memory of foreign residents,—the panic that existed respecting supernatural clipping of queues,*—and had for its object the diffusion of useful knowledge on the calamitous visitation, the treatment of sufferers and suppression of sorcery, the cause of the mental and physical distress that then prevailed over a large portion of the Empire, besides which the volume unfolds the arcana of ancient theurgic lore on this recondite matter. That production and personal observation form the basis of the following account of the remarkable delusion by which the Empire for many months was strangely infatuated. Little is to be gleaned from the work respecting previous epidemics of the same nature; it, however, gives dates of such periods of frenzy that have occurred in his part of the country as found recorded in local gazetteers. They occurred in the following order, in the years of our Lord 1464 and the following year, 1529, 1596, 1657 and 1753. The earlier period named shows that the delusion was nearly concurrent with the beginning of witch-mania in Europe, or the date of the bull of INNOCENT VIII. Happily, the delusions in China were not intensified by religious fury, and women have seldom been regarded as addicted to sorcery, although they are etymologically implicated. Yao, magical, elf, bewitching, and the like, is composed of “woman” and “winning.” An author of the middle of the 17th century is quoted, who gives an account of the epidemic of 1657, occasioned by wizards from the north of the Yangtze, who appeared at Chingkiang and Changchau. They possessed the power of fascinating or enchanting men whom they met abroad, so that simply calling them by name they were enabled to allure them to another city and sell them by a sort of “hypnotising,” a process somewhat analogous to influences of the “evil eye,” although neither this world-wide superstition nor the myth of the fascinating power of serpents or basilisks seems to have prevailed in Eastern Asia. The hypnotised being sold by their captors through Soochow and Changchau brokers led to the suppression of the practice; the brokers were severely punished, and the sorcerers quitted Changchau for Hangchau, where also they operated. For about a week, however, Changchau was troubled by spiritual manifestations which agitated the entire community. No one attempted to sleep by night, owing to numerous weird phenomena; rafters and tiles of houses shook with fearful noises, vapourish phantoms were observed, having a frowsy smell, these at times being the size of a peck measure, and suddenly expanding to the size of a house, being, in fact, black demons assuming various shapes, as, for example, that of a fox with an enormously distended mouth, and eyes like stars, or transforming into the figure of a horse or dog. These shadowy ogres entered houses and smothered people to death, or scratched and clawed them till blood flowed. Attempts were made to smite them with swords, but the swordsmen merely succeeded in hacking themselves. Of only one thing were these agents of sorcerers afraid,—that was noise. By the continued beating of gongs, of

* The “paper men” and queue-cutting craze evoked an Imperial decree (*Peking Gazette*, 15th October 1876), also a report from the Governor of Chêhkiang (*Peking Gazette*, 9th November 1876), in which documents it appears that the Government regarded the excitement as being aimed at Christian missions.

metal or wooden implements, and by shouting, from sunset to sunrise, the magical apparitions were kept out of houses, and in seven days they entirely disappeared. At that time, and previously, the population had suffered from effigies of men drawn on paper, which being enchanted and scattered became a source of great annoyance, particularly by clipping portions of queues; the hair being conveyed to the sorcerers, gave them power over the lives of the despoiled. Doctor CHOU had with him a temporary lodger who announced that he would sell charms to break all spells of that kind. He sold them cheaply and had many purchasers, but some malicious persons gave out that he himself was a sorcerer; a mob seized him, took him to the magistrate, by whom he was tortured for a confession till he died. Our author states that he himself doubted the truth of traditions which described the machinations of sorcerers, but the prevailing epidemic convinced him that the evils had not been exaggerated, for since the rise of the existing panic he had ocular demonstration of an apparition of a *yao*, a bewitching demon. Its eyes were like flashing mirrors; the phantom vanished, however, as soon as he had recourse to incantation, a recitation of a well-known spell-breaking rhyme. Consequently, he took up the subject and searched for plans that had been found efficacious in former visitations of the same nature; these he supplements with formulæ of his own and those of other modern investigators. The title that he adopts for his work, *An Account of Anthelmintics*, or worm remedies, is drawn from ancient and meturgico-medical writers, who describe seven different kinds of parasites or "venomous worms" that prey on the human system and which are not amenable to ordinary treatment, but require supernatural measures, united with articles of the materia medica, as antidotes. The agents employed by sorcerers are likened to those worms, and hence the combating agents are styled vermifuges. It appears that Kwangtung and Kwangsi are most noted for worm-poisoning.

Charmed bits of paper representing men are scattered by sorcerers, which are vehicles for sending out their ghostly emissaries. When by any means these spirits gain admission to a dwelling, they begin to injure the inmates, most commonly by clipping bits of a queue; the hair thus coming into the possession of the sorcerer, he can summon at will the soul or spirit of his victim, which he employs ever after as a servile demon, or "familiar," according to mediæval parlance,—the victim, of course, dying by the loss of his spirit. Sometimes the demons which are sent on the charmed paper thrust needles into the bodies of the victims, and at other times seal or stamp their skin by discoloured spots. At other times the demon personates a pedlar and palms off charmed commodities, victims being tempted to become purchasers by the extreme cheapness of the article. It was in this way that a Changchau man fell a victim to demons. He purchased a pair of scissors, and the same night cut his own throat with the charmed implement; and a man in Kiukiang came to grief by purchasing an enchanted melon. At night he heard some one calling him by name; he rose, but could see no one; at daylight he found himself bereft of all his hair.

Another mode of bringing people under demoniacal influence by sorcerers or practitioners of the black art is through the agency of animals—rats, bats, sparrows, butterflies, beetles, centipedes,—anything, in fact, that has life can be employed for their maleficent schemes.

The first symptom of invasion of the occult malady is pain in the stomach; after this the virus is diffused through the system. In children a few days suffice for that end; in

General, and is to be worn as an amulet. No. 3 is from the same functionary, and is for posting on doors; the figures are known only to the initiated, our author not having fathomed their mysterious depths. The promulgator of these is named CHANG, and has for his official designation, "Heavenly Teacher." He is a simple-minded, unpretentious character, and so mistrusts his power in ordinary diseases that he consults me through messengers concerning his ailments. I made the acquaintance of his holiness when he was on a visit to the Faithful of the Coast, from his seat, Dragon-Tiger Mountain, Kwangsin, Kiangsi. In his palace are innumerable sealed jars in which captured or exorcised demons are imprisoned. Besides the duty of bottling the imps of the country, he makes appointments of tutelary guardians in every palladium temple in the Empire. By his potent magic wand this master wizard wields dominion over the spirits of the universe, protecting the State from their mischievous acts, and families from their malevolence.

Our author, after enumerating a large number of the innumerable arts by which sorcerers afflict their victims, states that they are to be met by means both foul and fair; the former being the employment of unmentionable filthy rags, dogs' blood, and whatever is nasty; the latter consists in the use of orthodox writings, the recitation of which is deterrent and exorcising. The first chapter of the *Great Learning* or of the *Due Medium*, or the 64 diagrams of the *Book of Changes*, or the ever-cherished verses of the martyred patriot, T'EN FENGCHOW, also a well-known jingling gibberish, as an imprecation. The classics are believed to possess talismanic virtue in protecting dwellings from all terrene and supermundane noxious agents, and when a house is constructed a box containing copies of the *Four Books* and the *Five Classics*. By these means, combined with carrying hartall and other medicines in the belt, hanging up branches of the peach tree in the house, by noises from gongs, drums, fireworks, or otherwise, demons may be driven off.

The epidemic which called forth the book under consideration continued for about eight months, from Canton to regions north of the Yangtze and as far west as the lake provinces. It was surmised at the time, and fully established afterwards, that the panic was the concerted work of secret seditious societies having revolutionary aims. A few myrmidons in each large city sufficed to create a stir by deftly clipping the queues of the unwary, and then announcing in places of public resort that they themselves had suffered in the same mysterious way. When a few well-attested cases occurred, the cause, by common consent, was referred to paper men set loose by sorcerers, and then if one suffered from nightmare, or found a blotch on his skin, or had an attack of colic, the cause was attributed to sorcery. In a word, everything that went wrong in a city, death from apoplexy or suicide, the loss of some article, or any unusual noise or dream, a phantom,—all were supposed to be the work of the invisible enemy; while some, from the mere pleasure of attracting attention and becoming objects of remark, fabricated sensational stories until a form of cerebral disease was induced in weak persons, which contributed further to fan the flame of wild superstition.

Having disposed of the therapeutic portion of his essay, our author proceeds to counsel prophylactic measures. The agents of sorcerers infest opium-dens, tea-shops, and are to be seen lounging at temples or hiding in forests, hills or caverns. Let all suspicious persons be sought out by the gentry and elders, apprehended, and sent to the magistracy. Here, however, he

interposes a needful caution, inasmuch as he hears that the criminal class band together as sorcerer-hunters, and plunder travellers on pretext of searching for proofs of connexion with those dreaded men, dexterously sticking needles of foreign manufacture on the person under search, and then exacting blackmail, which the sufferer ordinarily submits to. Soon after he meets with another sorcerer-hunting party, who, finding him penniless, take his clothes and his life as well. This is no fancy sketch, for it is well known that transactions of that kind took place subsequent to the publication of the *Anthelmintic*. Nor were the murderers ruffians only; well-meaning but panic-stricken villagers seized and executed travelling merchants under the belief that self-protection necessitated summary proceedings. It is much to the credit of the common people that, under the frenzy that seized them, they almost invariably took the suspected to the *yamêns* for judicial examination. Our author affords a glimpse of the character of judicial examination of persons suspected of complicity with sorcerers. In Hupeh an emissary was brought to trial, and it was found that under torture—trial in such cases includes torture—nothing could extort confession, nor even a cry or moan; but when some charmed plasters were removed from his armpits and the soles of his feet, and when a loathsome emetic was poured down his throat, he cried out and vomited forth the truth, admitting that a sorcerer paid him \$1 for every tuft of hair that he cut, half that sum for sticking needles, and something less for stamping skins—in a word, the miserable wretch admitted all that the inquisitors sought to establish. In this way it was discovered that sorcerers direct their emissaries to reconnoitre the premises by day disguised as priests, beggars or pedlars, of places to which the paper men are to be conveyed at night, the paper men bearing the spirits of the emissaries. In view of the above, it is directed that when one awakens at night suffering from a sense of suffocation, he is to seize a dish-cloth and press it down on the spot where the missive is supposed to be, to hold it fast until someone goes out in search of the sorcery agent, who will be found sleeping in some adjacent house. On rousing the sleeper he will be found stupefied from the absence of his spirit; held under the dish-cloth he may then be easily led to the magistrate. In this manner five miscreants were seized at Wuhsi.

At Ningkuo, in Anhwei, enemies of the mission there pointed to a chapel as a place whence paper effigies of men were dispersed, and leading a mob, showed them a basketful of the effigies as proof, they themselves having placed them here. The populace became so exasperated that violence and loss of life followed. The leader hastened to the capital to get authority for further proceedings, but was cast into prison by the Governor, from which time the excitement subsided.

Widespread panics like that of 1876 are not of frequent occurrence, but crazes in a limited area are not uncommon, showing that the section of the Penal Code which provides punishment for persons found guilty of originating false rumours is necessary for the public safety. Two instances of local panics may be adduced, as they resulted from early foreign intercourse. At Ningpo, soon after the opening of the port, a single lady was in the habit of taking early walks on the city walls, a portent that needed explanation. She was not a maniac let loose, as was testified by her immediate neighbours, who stated that her only aberration consisted in going out of the way to do good. It was finally decided that she went on the ramparts to scatter paper men for bewitching and subjugating the inhabitants. To neutralise her

magic the entire population engaged the whole of several successive nights in gong and drum beating, firing off crackers, and shouting, by which the spell was broken and security ensured.

Sometimes it will be found that a wily scoundrel sets a town in a ferment to accomplish some sinister object. An instance of this sort occurred at Wenchow several years before the port was open for trade. A literary graduate who devoted himself to fomenting disputes and espousing cases of litigants—a man of great force of character, who lived by his wits, was regarded as an oracle in foreign affairs, who was more feared than respected, who was inextricably involved in financial affairs—announced confidentially to all he met that he had discovered there was a calamity impending over the city, the precise nature of which he was unable to ascertain, but this much was certain, a fleet of vessels filled with foreign women, of hideous mien, with long carrotty beards, would soon be found at the mouth of the river. If particulars were wanted, they might be wormed out of the only foreign resident, a missionary, to whom this scalawag referred all whom it concerned. The consequence of this was that the missionary was shunned as if he were a leper. In truth, there was something mysterious about the foreigner, a man of herculean frame and commanding mien, sustaining himself with a pair of wands. People had not yet fully made the acquaintance of that estimable gentleman, whom they now love, but regarded the crutches which sustained him, he having lost a leg, as capable of turning the city upside down. Before the ferment had time to subside, the graduate received information that the hecates had arrived at the mouth of the river, when he declared that for his part he had done his duty by the public, and now he would see to the safety of his family and take them up-country, and let the red-haired hecates catch the hindmost. Before he was well off with all his belongings, the quay was rendered impassable by piles of effects of every description, which the well-to-do were conveying to boats, with wives, concubines, children, and domestics. Business was suspended, shops were closed, people stood aghast and were paralysed; they appealed to the authorities. The Taotai sent for the missionary, assuring him that he was displeased by the popular exhibition, and forthwith he issued a soothing proclamation, which quickly allayed the commotion. It was not long before the facts of the case transpired,—that the whole affair was a ruse by the graduate, who could not otherwise get out of town. Everyone smiled except his ill-starred creditors.

At the present time, according to a native correspondent of the *Shên Pau*, two medical sorcerers are exercising a powerful sway over a large portion of country bordering the Great Lake. They are dames, but assume and are accorded the title of unmarried women, implying that they are a sort of fairy. By charms they secure exemption from diseases, and by incantations they inflict disease on those who decline paying for the promised immunity. They have obtained such an ascendancy that when an illness occurs it is ascribed to their vindictiveness, and their aid is invoked. There are none so poor as not to be taxed—a dollar or so per annum,—the rich paying a hundred or more dollars. They employ several tens of men in collecting fees, and these myrmidons have become so exacting that their depredations are likened to those of robbers, and represented as more destructive than fire or flood.

These glimpses at the everyday life of the people show the need that exists for the means now in use for their enlightenment. In the diffusion of correct views regarding the seen and the unseen universe, the periodical press is a most important agency, and the demand for newspapers is an earnest that the clouds of superstition and ignorance, which

are sources of manifest weakness to the Empire, will be gradually dissipated; gradually, not quickly, for, as the West knows too well, a period of dark and dreary ages is not susceptible of rapid change.

These glimpses at the social life of the Chinese disclose much suffering through ignorance and superstition, yet they do not seem to have been afflicted with delusions so disastrous as the witch-mania of our dark and dreary ages, which, it is computed, caused 9,000,000 persons to perish at the stake. Happily, the means which gradually enlightened and emancipated our progenitors are now in active operation throughout the land, diffusing correct views both of the seen and unseen worlds, the periodical press being among the most promising.

The recent discovery by DA SILVA LIMA of Brazil of the existence in that country of the Indian disease beriberi, and its later discovery in Japan by Dr. SIMMONS, show that that malady has a wider range than was supposed. On turning to certain translations that I made from the Chinese, and from late verbal inquiries, I find that beriberi is well known under the designation "malarial leg"—*kioh-k'i*, the same word which the Japanese pronounce *kakke* (脚氣). Not being familiar with the characteristics of the Indian malady, it did not occur to me that the Chinese malady and the Indian were identical until I read Dr. SIMMONS' paper on "Kakke" in Japan.

Inquiry into the literature of malarial leg ascends to the misty and undefined period when the semi-mythic and proto-historic narratives of China interlace; it necessitates a critical study of Chinese archæology, subjects which are hardly germane to a medical report. This much, however, is relevant. A disease named *kioh-k'i* or *chiao-ch'i* is described in the *Neiching* (內經), or rather in the *靈樞經*, doubtless the oldest medical treatise extant,—a work attributed to HWANGTI, B.C. 2697,—although it has no claims to antiquity much, if any, beyond the period of the early CHOU or the sources whence CONFUCIUS compiled his annals. According to a writer quoted by SHÊN LANGCHUNG in his work on *Etiology* (沈朗仲病機彙論), the "chüeh" (厥) (a word meaning stone-throwing implement, which contrivance was probably named after the disease) is the "malarial leg," which during the HAN dynasties was called the "slow wind disease," and that in the SUNG sway it obtained its present designation; but the description does not apply to this disease at all,—it means a sort of syncope. It was also during that period that the earliest known monograph appeared on the subject, *Generalisation of the Treatment of Malarial Leg*,* a work long lost, but named in the Imperial Catalogue and described or copied into the great work of YUNG LOH. It is in two volumes or chapters, the last containing 46 prescriptions. Since the SUNG the disease is found described in all systematic treatises on the healing art. Two forms of the malady are recognised, which correspond with *beriberi hydrops* and *beriberi atrophica*, and, as the name of the disease indicates, their etiological views accord with those of Western observers. "Malarial leg" is caused by a poison emanating from the soil. There are two kinds, one due to moist heat, the other to moist cold. It is engendered at any season of the year by prolonged sitting or standing in a damp place, also by suddenly suppressed perspiration.

* 脚氣治法總要, published between the latter half of the 10th and latter part of the 13th century, and is probably the work referred to by Dr. ANDERSON of Tokio as having been republished in Japan. *Vide* his pamphlet on the subject and Guy's Hospital Reports.

as when one is heated by the weather or by spirits, and disrobes when in that condition; and, according to the patriarchal Emperor, by venereal indulgence when under the influence of liquor. In the moist heat kind the pulse beats fast; in the moist cold kind it beats slowly. When the poison rises from the legs to the heart, the mind is affected, the patient mutters, there are loss of appetite and vomiting, restlessness, difficult respiration and scanty urine. In the moist warm form of the disease, the legs are painful, and there is fever; in the cold moist form, the limbs are not painful, and there is no fever. The mouth in both kinds becomes black, the skin and flesh are painful, particularly on the sides of the chest, and the tendons become prominent; these symptoms extend gradually to the face and head. Besides moisture as the exciting cause of the disease, errors in diet are named as predisposing causes. Why has this disease hitherto escaped detection in China? That is due partly to the fact that the disease is not a common one, and partly because it belongs to a class of maladies for which the intervention of foreign physicians is seldom made. Now, however, that attention is called to the subject, cases are likely soon to be reported. I have heard of one case only—the subject having but recently engaged my attention. It was that of the mother of a Chinese officer of the Imperial Maritime Customs. It was an acute attack, and terminated in one week, fatally. Native physicians pronounced the affection to be malarial leg, and from what is reported it seems clear that it was a case of the wet form of the malady.

There is reason to believe that it prevails in Tungking, and it is not unlikely that it is the disease called “mauvais vent” by Abbé RICHARD.*

Epidemics of a very destructive kind prevail among cattle, including the buffalo. The autumn of 1877 was remarkable for devastation from a murrain in which vast numbers of domestic animals of every kind perished (the preceding summer was a cholera season). Horned cattle, including the cow and buffalo, horses, goats, pigs, dogs and poultry, all suffered,—the bovine race from rinderpest; goats suffered from a foot-and-mouth disease; with regard to the others my information thus far is defective. The Taotai then ruling was a gentleman of great benevolence, and rigorously enforced the law which (not, however, to the extent of the magistrate at Nanking, who about the same time beheaded a Mussulman butcher for the offence) prohibits the slaughter of cattle, and by way of compensation to farmers whose animals were superannuated, and from compassion for worn-out cattle, he established an asylum where the animals were cared for during the balance of life. There were several hundred of these in sheds situated outside the West Gate, but they all succumbed to the pest immediately after an infected cow was introduced. The area over which the epidemic prevailed remains to be ascertained; it affected the whole of this province and portions of Kiangsu and Anhwei.

Two years later, 1879, a murrain of unusual violence prevailed among bullocks and camels in Mongolia, the transportation of tea between Kalgan and Urga being much impeded in consequence. A standard work on cow diseases (牛經) gives stercoraceous and mucous

* “Le mauvais vent (*Sinich*, morbific vapour?) est une autre espèce qui nous est inconnue. Le mauvais vent ou l'impression subite d'un air froid, chargé d'exhalations locales, glace tout d'un coup le sang et fait mourir sur le champ plusieurs personnes; d'autres ne sont qu'estropiées de quelques membres: le plus souvent, la bouche se déforme et tourne comme dans une attaque de paralysie. Lorsque l'impression est légère on en guérit en se réchauffant. Il y a des remèdes spécifiques contre ce mal s'ils sont administré à temps.”—*Histoire naturelle, civile et politique du Tonquin*, par M. l'Abbé RICHARD, Chanoine de l'Église royale de Verelai: à Paris, MDCCLXXVIII.

vomiting as pathognomonic of a common epidemic, but it affords no other information that merits transcribing. Pig murrains do not often occur synchronously with cattle plagues. Dr. PORTER SMITH's discovery of trichinæ of pork at Hankow,* and Dr. MANSON's detection of them at Amoy (see last Customs *Medical Reports*), indicate that parasite to be widespread. Further inquiry will probably lead to the discovery of trichiniasis, although, for the reason assigned by Dr. MANSON, the thorough cooking to which pork is subjected in China, the disease probably is of rare occurrence.

Wênchow is an opium producing region and an opium importing one as well. The domestic product is employed largely to adulterate the Indian article,—Patna, not Malwa, opium being thus employed. Native opium, being deficient in alkaloids, produces comparatively transient effect on the system; two or three hours after inhaling the smoker yearns for more whiffs of the pipe. It would be a work of supererogation at this date to comment on the demoralising effects of the use of opium or on its pathological action, but there is scope for remark on medical means of reforming smokers, and on the effects of the habit as it affects reproduction. Nine months ago the Inland Mission established a hospital for ophthalmic and opium patients under the care of A. W. DOUTHWAITE, Esq., who has in that period of time treated above 200 patients, all of whom quitted the institution as cured of the habit, having been under treatment four weeks each on an average.† There is no charge for admission into the institution, patients merely paying for sustenance. The average amount of opium daily

* *Contributions to the Materia Medica and Natural History of China.*

† Since writing the above, the *First Annual Report of the Wênchow General Hospital and Opium Refuge*, by Mr. DOUTHWAITE, has appeared. I append the statistics as affording useful information on the subject of this paper:—

ANTI-OPIMUM HOSPITAL STATISTICS.

Number of patients admitted	213	Number of patients incurable	2
„ „ cured	209	Expelled for bad conduct	2

NUMBER OF YEARS SINCE SMOKING WAS COMMENCED.

9 had smoked 1 year.	4 had smoked 9 years.	1 had smoked 19 years.
10 „ 2 years.	14 „ 10 „	2 „ 20 „
21 „ 3 „	11 „ 12 „	1 „ 21 „
18 „ 4 „	4 „ 14 „	2 „ 23 „
25 „ 5 „	13 „ 15 „	2 „ 24 „
29 „ 6 „	5 „ 16 „	5 „ 25 „
12 „ 7 „	4 „ 17 „	1 „ 29 „
17 „ 8 „	3 „ 18 „	

AGES OF PATIENTS.

Under 20	3	Over 40 and under 50	52
Over 20 and under 30	64	„ 50 „ 60	14
„ 30 „ 40	79	„ 60 „ 70	1

AMOUNT OF OPIUM CONSUMED DAILY BY EACH MAN.

7 consumed 1 mace.	41 consumed 5 mace.	3 consumed 9 mace.
23 „ 2 „	17 „ 6 „	5 „ 10 „
45 „ 3 „	11 „ 7 „	1 „ 12 „
49 „ 4 „	10 „ 8 „	1 „ 15 „

Average, $4\frac{1}{2}$ mace.

$4\frac{1}{2}$ mace per day is 1,642 mace, or 10 catties 4 liang= $13\text{ lb. }6\frac{1}{2}\text{ oz. avoirdupois, per annum.}$

If we consider those who have entered the hospital as fairly representing the opium-smokers of this city, and accept the *lowest* native estimate of the number of smokers—i.e., half the adult males,—then reckon the population at 80,000, we shall find there are at least 10,000 opium-smokers in the city.

smoked by patients treated at Peking by Dr. DUDGEON was $4\frac{1}{2}$ mace, that of Mr. DOUTHWAITE'S

At the above average of 10 catties 4 liang per annum, 10,000 men would require 102,500 catties of prepared opium for their yearly consumption. Crude opium loses in the process of preparation about one-third in weight; accordingly, 102,500 catties of the extract represents 132,950 catties, or about 1,329 chests of the crude drug.

As only 58 chests of foreign opium paid Customs duty here last year, a great quantity must be smuggled, or brought overland from Ningpo, to supply the market.

QUALITY OF OPIUM SMOKED.

69 smoked Malwa.

25 smoked Patna.

119 smoked native.

The Indian opium contains from 8 to 15 per cent. of morphine. The native drug is only about one-third that strength as it is sold in the shops, but in the Suian district, about 30 miles south of Wênchow, a very superior drug is produced, which those who smoke it declare to be equal to Patna. An opium planter from that district told me that a great quantity is annually sent over the borders to Fukien, where it is sold as Indian opium. It does not become soft when exposed to the air as the Wênchow and Taichau drug does.

	FOREIGN.	NATIVE.
Largest quantity smoked daily	8 mace.	15 mace.
Smallest " "	1 "	2 "
Largest quantity eaten	1 "	5 "

TIME SPENT IN HOSPITAL.

Longest	40 days.
Shortest	8 "

Average, 21 days.

On leaving the hospital each man takes a supply of tonic medicines, so the average period of treatment is about 30 days.

The following statistics will show the work done during the past 12 months:—

GENERAL HOSPITAL STATISTICS.

Number of out-patients treated during the year	4,030
" in-patients " "	45

NATURE OF DISEASES TREATED.

Eye Diseases:—

Purulent ophthalmia	47
Gonorrhœal "	9
Granular "	86
Conjunctivitis	46
Entropion with ulceration of cornea	1,626
Granular lids	205
" " with ulceration of cornea	1,030
Superficial ulcers of cornea	190
Deep ulcers of cornea	27
Pterygium	98
Iritis	9
Cyclitis	3
Cataract	2
Night blindness	15
Asthenopia	20

Eye Diseases—cont.

Amblyopia	40
Abscess of orbit	2

General Diseases:—

Syphilis	32
Rheumatism	68
Ulcers and abscesses	146
Ague	57
Bronchitis and asthma	90
Pulmonary consumption	8
Dyspepsia	107
Anæmia	103
Hepatitis	5
Nasal polypi	3
Harelip	1

TOTAL 4,075

OPERATIONS PERFORMED.

For cataract	2
" pterygium	98
" entropion	160

For abscess of orbit	2
" harelip	1
" nasal polypus	3

TOTAL 266

patients was 3 mace 2 candareens. So extensive is the demand for anti-opium medicines that there are no city walls in the Empire that do not contain the placards of charlatans whose pills, it is vaunted, effect a perfect cure of opium-smoking desire; many of these nostrums are advertised as prepared under foreign auspices, a ruse which facilitates their sale. Opium in some form is always an ingredient of those pills which are most efficacious, and no doubt they effect much good. So long ago as 1844 I adopted a mode of treatment which may be called "thorough," in contradistinction to the above lenitive measures. It consisted in withholding from the first the accustomed narcotic and in combating the fearful consequences. A few hours' deprivation of the drug induces a colliquative diarrhœa, soon followed by seminal emissions, pain in the lumbar region, and an utter prostration. Stimulants, astringents, tonics and nourishing diet served to prop up the miserable patient until a desire was engendered for the new form of excitement, which seemed to bridge over the chasm which separated him from his former life. A taste for alcohol was never acquired by such patients, and there was no difficulty in reducing the dose until it was discontinued altogether. Patients who are cured by the lenitive method are liable to relapses. When tempted, they feel that an easy remedy is within reach, and that there is no danger of a little indulgence proving utterly ruinous, but he who has passed through the "thorough" ordeal is so impressed with its horrors that death by torture could have no greater terrors for him than a repetition of like treatment, and having been emancipated at such a cost he is hardly likely again to become enslaved. Physically and morally speaking, he has taken a new departure, and gradually recovers manhood in every sense; he, however, again becomes liable to attacks of malarial fever and catarrhs,—the narcotic, and a suggestive fact it is, affording him immunity from those disorders. I published an account of my mode of treating opium-smokers* many years ago; it was adopted by the late Dr. OSGOOD of Foochow, who found the new medicine, chloral hydrate, of signal use in meeting the cravings of the patient.

The seminal discharge which speedily follows disuse of opium is noteworthy when considered in connexion with its early use as an aphrodisiac and its employment in bagnios to protract orgasm, and such being the case it is not matter of surprise that its continued action conduces to impotency. To the effects, then, usually attributed to opium-smoking where it is a national habit must be added that of its being to an appreciable extent a check to the growth of population.

The Customs Report on Opium† shows—first, that, allowing 3 mace per day as the average amount of opium consumed by each man, the foreign market supplies only sufficient opium for 1,000,000 of the population; second, that the population of China is about 300,000,000; and third, that the native produce equals at least the amount exported; and therefore that opium-smokers constitute only a third of 1 per cent. of the population. Allowing, as a rule—and the exceptions are extremely rare,—that only the male part of the population smoke opium, and that none under 20 years of age are its victims, we obtain a more accurate view of

* *Chinese Repository*, August 1851.

† *Chinese Imperial Maritime Customs: Special Series: No. 4, Opium*. Published by order of the Inspector General of Customs. Shanghai: Statistical Department of the Inspectorate General, MDCCCLXXXI.

the number of opium-smokers, for the number of men over 20 years of age must be, on the above, about 60,000,000. Therefore we may say that 1 in 60 of the adult male population consumes foreign opium, and the same number consume the native drug; in other words, that about $3\frac{1}{2}$ per cent. of the male population over 20 years of age smoke opium. My own inquiries concerning the amount of opium of native growth in China place it at over four times that of the imported article, which indicates a much larger per-centage of unvirile. This, in view of the fact that population in China is constantly pressing on means of sustenance, may not be thought greatly deplorable, but when it is considered that the progeny of the opium drunkard who has not reached the last stage of decline are indubitably degenerate and inheritors of a propensity to indulge in the emasculating habit, the magnitude of the evil defies the computations of the statistician and eludes the ken of the political economist.*

As the *materia medica* of China has merited and received attention from foreigners, so their *materia alimentaria* is worth investigating. Culinary and dietary regulations abound. Particular attention, for example, is called to the importance of selecting edibles for the same meal that are not incompatible; articles which when taken separately are wholesome become noxious when in combination, so much so that such are classed among poisons. The most noted of these is a mixture of honey and onions. In some provinces they are employed for suicide, and cases are frequently reported of deaths from that cause. The great physician SUN SZEMIAO (early 7th century canonised) is quoted in the *Péntsao* as stating that raw onions and honey induce purging, and that honey and cooked onions cause death. Doubtless the two combined are so indigestible that, sustained by high medical authorities, they are popularly regarded as poisonous. In like manner honey and Chinese dates (*Zizyphus jujuba*) are interdicted. So also eel and sugar-cane. A death at Shanghai was lately reported from eating crab and persimmons.

In various parts of the Empire and for several years I have sought information on colour-blindness, interrogating painters, dyers and others likely to become acquainted with that visual defect, without finding evidence of its existence. Lately, through the courtesy of Mr. DOUTHWAITE, I obtained the services of his hospital native assistant in subjecting to examination above 1,000 applicants for relief at that institution. The result of the examination, and that which I myself made among the crews of gun-boats,† failed to afford evidence of the existence of Daltonism.‡ The rarity, if not absence, in China of that defect of vision, or rather of the sensorium, and the absence of evidence of its existence except among Europeans and Americans, is suggestive of inquiry if this chromatopseudopsis is not an ethnic characteristic. The examinations instituted in India among candidates for employment on railways were probably restricted to Eurasians, and the cases there discovered may not have been those of natives. Nubians, it has been lately ascertained, are free of the defect.

* The impartial chronicler of opium discussions in China will not overlook the fact that the cultivation of opium in the country is favoured by writers of note. In November last the semi-official *Hsin Pau* had a cleverly-written article defending the culture and use of opium on economic grounds.

† Captain FARROW, of the Customs cruiser *Ling Feng*, and several commanders of Chinese Imperial gun-boats, kindly allowed me to subject their men to examination.

‡ The irides of those examined were generally dark hazel, the others black—colours prevalent in China.

It having been demonstrated that from 5 to 7 per cent.* of Americans and Europeans are at fault in distinguishing between colours, red and green for example (signal colours), it is presumable that among the hundred or more pilots of the China coast there are several who are thus disqualified from following that vocation, and it would only be in accordance with recent legislation in the West if that most useful class of our fellow-residents were subjected to the usual tests for colour-blindness. At Baltimore recently a pilot who had served 25 years without a collision had his license withdrawn because he was unable to distinguish green from red; which shows that the defect may long exist without mischievous results, and the importance which marine authorities attach to the not too common faculty of discriminating colours aright; at the same time it must be admitted that the Baltimore case seems confirmatory of the opinion of Mr. POLE,† who himself has the defect of "dichromic vision," that there is no more danger of colour-blind engine-drivers or pilots mistaking red for green signals than are those of normal vision, no train or ship collision having thus far been traced to that defect.

Vaccination is making considerable progress in many provinces. Physicians in large cities who make a speciality of infantile diseases often include vaccination in their practice, but the new art is chiefly followed by persons who make it their sole occupation. Unfortunately, the extension of this great improvement cannot be viewed with unmixed satisfaction. It is to be feared that ignorance or dishonesty on the part of vaccinators may delude whole communities by spurious operations, the baneful consequences of which will become apparent when a small-pox epidemic of unusual virulence appears, that disease presenting various phases of violence, from a mild to a terribly malignant form. A reaction may then be looked for which will dispel confidence in the prophylactic,—a danger which will menace society until magistrates interdict the practice of inoculation to all persons not duly qualified and licensed. I am informed by Mr. DOUTHWAITE that at Kihua vaccination has been taken up by the Buddhist priesthood, their temples having recently become the resort of mothers carrying their infants there for the operation, having implicit confidence in sacerdotal intercession with the gods for success; and as the fraternity surround the act with mystery and imposing ceremonies, they are likely to monopolise the new vocation. In like manner, secular practitioners of vaccination have been induced to resort to various devices to impress parents with the supernatural character of the rite, directing them to make pilgrimages to certain shrines, and the like, during the period of incubation. A native Christian vaccinator who would not thus deceive the people has lost all his practice, and obliged to adopt another calling.

Vaccination will not speedily supersede inoculation, which, since its introduction from Thibet (A.D. 1023-1055), has served to mitigate the violence of small-pox, which was introduced, as I formerly showed, in the 1st century from the then foreign region of Hupeh by the army of the renowned hero MA YÜAN.

* Dr. WILSON found among 1,154 men (about the number examined here), 17.7 per cent. to be colour-blind.

† "Daltonism," by WILLIAM POLE, F.R.S., *Contemporary Review*, May 1880.

Two writers in *Nature*, both having for their theme "Skin-furrows on the Hand," solicit information on the subject from China.* As the subject is considered to have a bearing on medical jurisprudence and ethnology as well, this Report is a suitable vehicle for responding to the demand.

Dr. FAULDS' observations on the finger-tips of the Japanese have an ethnic bearing and relate to the subject of heredity. Mr. HERSCHEL considers the subject as an agent of Government, he having charge for 20 years of registration offices in India, where he employed finger marks as sign manuals, the object being to prevent personation and repudiation. DOOLITTLE, in his *Social Life of the Chinese*, describes the custom. I cannot now refer to native works where the practice of employing digital rugæ as a sign manual is alluded to. I doubt if its employment in the courts is of ancient date. Well-informed natives think that it came into vogue subsequent to the HAN period; if so, it is in Egypt that earliest evidence of the practice is to be found. Just as the Chinese courts now require criminals to sign confessions by impressing thereto the whorls of their thumb-tips—the right thumb in the case of women, the left in the case of men,—so the ancient Egyptians, it is represented, required confessions to be sealed with their thumb-nails,—most likely the tip of the digit, as in China. Great importance is attached in the courts to this digital form of signature, "finger form" (指模). Without a confession no criminal can be legally executed, and the confession to be valid must be attested by the thumb-print of the prisoner. No direct coercion is employed to secure this; a contumacious culprit may, however, be tortured until he performs the act which is a pre-requisite to his execution. Digital signatures are sometimes required in the army to prevent personation; the general in command at Wënchow enforces it on all his troops. A document thus attested can no more be forged or repudiated than a photograph,—not so easily, for while the period of half a lifetime effects great changes in the physiognomy, the rugæ of the fingers present the same appearance from the cradle to the grave; time writes no wrinkles there. In the army everywhere, when the description of a person is written down, the relative number of volutes and coniferous finger-tips is noted. It is called taking the "whelk striæ," the fusiform being called "rice baskets," and the volutes "peck measures" (螺紋箕斗). A person unable to write, the form of signature which defies personation or repudiation is required in certain domestic cases, as in the sale of children or women. Often when a child is sold the parents affix their finger marks to the bill of sale; when a husband puts away his wife, giving her a bill of divorce, he marks the document with his entire palm; and when a wife is sold, the purchaser requires the seller to stamp the paper with hands and feet, the four organs duly smeared with ink. Professional fortune-tellers in China take into account almost the entire system of the person whose future they attempt to forecast, and of course they include palmistry, but the rugæ of the finger-ends do not receive much attention. Amateur fortune-tellers, however, discourse as glibly on them as phrenologists do of "bumps"—it is so easy. In children the relative number of volute and conical striæ indicate their future; "if there are nine volutes," says a proverb, "to one conical, the boy will attain distinction without toil."

* HENRY FAULDS, Tzukiya Hospital, Tokio, Japan. W. J. HERSCHEL, Oxford, England.—*Nature*, 28th October and 25th November 1880.

Regarded from an ethnological point of view, I can discover merely that the rugæ of Chinamen's fingers differ from Europeans', but there is so little uniformity observable that they form no basis for distinction, and while the striæ may be noteworthy points in certain medico-legal questions, heredity is not one of them.

It is matter of regret that quinine, the anti-malarial value of which the Chinese fully appreciate, should, owing to its cost, be unobtainable by the masses; it is a national evil and merits attention on the part of the Imperial authorities, who might, there is good reason to believe, do much towards its mitigation. From the result of experiments made by the Dutch in Java and by the English in India in acclimatising cinchona trees, there is sufficient encouragement to attempt their introduction into Yünnan and other southern portions of the Empire. An additional inducement is afforded by the fact that in India cinchona plantations have already become a source of revenue, the trees being found so rich in alkaloids that some plantations have yielded \$8,000 per acre. But for the successful acclimatisation of cinchona trees in those countries, the world would soon suffer from a quinine famine, as the cinchona forests of South America are in the course of rapid destruction. At the same time it is extremely desirable that the Imperial Government or the Governor-General of the southern provinces should be moved to introduce eucalyptus trees extensively, the prophylactic of malarial fever, which is so injurious to the best interests of the State. Private enterprise has accomplished something in acclimatising and cultivating eucalyptus, but the aid of Government must be invoked and obtained before that invaluable tree casts its protecting shade over the countless hamlets of fever-haunted regions where lurks the subtle foe of their inmates. The most successful of the attempts that have been made in that direction were with seeds kindly provided by Dr. ABBOTT of the Hobart Town Botanic Garden, to whom I applied for those of trees that flourished in the highest southern latitude and at the highest elevation, as most likely to endure the cold of a Shanghai or Ningpo winter. Although the various species that I experimented with failed in those ports, the plants rarely thriving beyond the third year, yet further south the result has been all that can be desired. It is true that recent observations are unconfirmatory of the anti-miasmatic properties of this exotic in Algeria and California, but if its prophylactic virtues have been exaggerated, there can be no doubt that its extensive culture would be advantageous because of the peculiar value of its wood.* A minister like Tso TSUNG-TANG, whose recent work of tree-planting in Kansuh is unequalled by any like feat in history, requires no solicitation to favour such an undertaking as the acclimatisation of useful plants.

Now that the Imperial Government favours the study by its youth of foreign science, it is not premature to lodge a plea in behalf of a scientific pursuit which is practically interdicted; that is, dissection of the human frame. In presenting the subject, it can be shown that neither army nor navy can be effective without a corps of duly qualified surgeons, and that anatomical knowledge is the first thing to be imparted to that branch of the military art, and that such knowledge is to be acquired by dissections alone. By presenting the subject

* I prepared an account of the eucalyptus, which was published in Mr. FRYER'S Chinese magazine, 格致彙編, in 1879, which induced ex-Minister Kuo to apply to me for seeds, which have thus far proved a success in southern Hunan.

discreetly, the prejudices which prevail may soon be overcome. With conservatives like the Chinese, precedent goes very far, and it might not be amiss to remind them how the Emperor HSIAO WU delivered up certain prisoners for a sort of vivisection, from which an inference may be drawn in favour of the delivery for dissection of the bodies of executed criminals. In the year 459 there appeared at the court of that monarch an embassy from the Yüehpan (悅般國), a tribe of Huns, whose southern boundary was the volcanic portion of the Tien Shan range. In the train was a magician who professed to be able to sever a man's throat and vessels, and come so near decapitating him that his head would fall back, and though basinsful of blood flowed, the administration of a drug would arrest the hæmorrhage and cause the wound to heal without a scar! Moved by curiosity, if not by a desire to promote physiological knowledge, His Majesty ordered the experiment to be tried on prisoners. The operation was perfectly successful, and restoration completed in a month. HSIAO WU liberally rewarded the magician, and directed the study of the art. It was remarked that the herb by which the cure was effected was to be found on certain famous hills in China.*

Coming down to a later period, we are told of a Governor ordering the evisceration of 40 criminals and *enceinte* women and children for anatomical purposes, causing examination of the viscera to be made by skilful physicians.† It may be fairly argued that if an Emperor of good repute committed prisoners to what he must have regarded as vivisection, and if a Governor ordered with impunity such cruelties on the living, surely a magistrate may consign the cadavers of the decapitated to anatomists for dissection, a course which, if discreetly done, will occasion no popular ferment, considering how eager the people of this city were the other day to witness the cutting out, by the public executioner, of the heart of a living malefactor: the thousands who witnessed the flagitious act were envied by the rest of the population who were debarred the spectacle. An additional inducement for the utilisation of persons capitally executed is afforded by the fact that it would probably serve as a deterrent to crime, owing to the dread of postmortem mutilation which is generally entertained by all classes of the Chinese. Evidence in support of the utility of postmortem examinations is furnished by the highest medical authority that the Chinese acknowledge, the *Péntsao*, which narrates the case of a man of rank, who, as well as his slave, suffered from abdominal pains. The slave succumbed to the malady, and the master, opening the body, discovered a red-eyed white turtle, on which he tried the effect of various medicines, none of which killed the animal; by accident, however, it was discovered to be soluble in horse urine, from which he inferred that that article, hitherto unknown as a medicine, would dissolve the tumour that occasioned him so much pain; he tried it and was cured. Since that time equine urine has held a high place in the pharmacopœia for treatment of visceral tumefactions and various other disorders. Its virtues as a medicine might never have become known but for the autopsy in question.

* 太平寧字記 (A.D. 976-983), book 186. In the Imperial Catalogue this celebrated work on topography is stated to consist of 193 books, which is one less than the actual number. Among my notes from this work, I find the following in relation to the Yüehpan: "Before each of their three daily meals they perform ablutions and gargle." Such an un-Mongolian custom is noteworthy.

† *Mémoires concernant l'Histoire, etc.*, tome viii, p. 261.

By adducing facts like these we may gradually reconcile the Chinese to the proposed innovation.

Supplementary Meteorological Note, January 1882.—The year just closed was remarkable for the extraordinary number of typhoons which devastated the China Sea, not less than 20 having been recorded, the last of the series occurring as late as the month of December. Allowing that certain cyclones were counted twice, it must be conceded nevertheless that the season in this respect was unprecedented. It may be remarked also that the fogs which regularly prevail in the latter part of April were denser, more protracted and wider spread than usual. The expression of COLUMBUS with regard to fogs which he encountered off Cape Verd, "that they might be cut with a knife," was peculiarly applicable to those of last spring on this coast and the Yangtze. Besides, the barometrical reading during December was remarkably high, in many places unprecedentedly so. At Wênchow, which is on the isobaric line, 30.02, the aneroid indicated a pressure of 31.20. It differs from the standard barometer of the Shanghai Customs. Coincident with the exceptional season has been, according to the *Sheng Pau*, an unusual number of epidemics in Kiangsu and northern Chêhkiang—autumnal diseases being rife, children chiefly suffering, while about the beginning of December puerperal fever raged in Soochow. Many cases were incurable, and within 10 days several tens of recently delivered women succumbed to the prevailing epidemic.

Dr. ALEXANDER JAMIESON'S Report on the Health of Shanghai for the
Half-year ended 30th September 1881.

ABSTRACT of METEOROLOGICAL OBSERVATIONS taken at the Observatory of the Jesuit Mission
at Sicawei, for the Six Months ended 30th September 1881. Latitude, $31^{\circ} 14' 32''$ N.
Longitude E. of Greenwich, $121^{\circ} 29' 8''$.

DATE.	Baro- meter at 32° F.	THERMOMETER.		Elastic Force of Vapour esti- mated in Inches of Mer- cury.	Hu- midity, 0-100.	Ozone, 0-21.	Velocity of Wind per Hour.	Mean Direction of Wind.	Total Evapor- ation during Month.	Total Rainfall during Month.	REMARKS.
		Diurnal Mean Temperature in Shade.	Extreme Temperature in Shade.								
1881.	<i>Inch.</i>	<i>° F.</i>	<i>° F.</i>	<i>Inch.</i>			<i>Miles.</i>		<i>Inch.</i>	<i>Inch.</i>	
April....	<div> <div>Max...</div> <div>Mean</div> <div>Min....</div> <div>Range</div> </div>	<div> <div>30.318</div> <div>29.958</div> <div>29.515</div> <div>0.803</div> </div>	<div> <div>57.5</div> <div>79.2</div> <div>...</div> <div>43.9</div> <div>35.3</div> </div>	<div> <div>0.725</div> <div>0.389</div> <div>0.170</div> <div>0.555</div> </div>	<div> <div>99</div> <div>80</div> <div>35</div> <div>64</div> </div>	<div> <div>21</div> <div>13</div> <div>7</div> <div>14</div> </div>	<div> <div>29.26</div> <div>10.54</div> <div>0.00</div> <div>...</div> </div>	S. 71° E.	2.461	4.726	Fifteen days rain.
May.....	<div> <div>Max...</div> <div>Mean</div> <div>Min....</div> <div>Range</div> </div>	<div> <div>30.319</div> <div>29.936</div> <div>29.651</div> <div>0.668</div> </div>	<div> <div>64.6</div> <div>82.6</div> <div>...</div> <div>49.5</div> <div>33.1</div> </div>	<div> <div>0.744</div> <div>0.475</div> <div>0.236</div> <div>0.508</div> </div>	<div> <div>94</div> <div>79</div> <div>35</div> <div>59</div> </div>	<div> <div>17</div> <div>13</div> <div>7</div> <div>10</div> </div>	<div> <div>21.82</div> <div>7.56</div> <div>0.62</div> <div>...</div> </div>	S. 67° E	2.262	3.690	Fifteen days rain. Storms on the 1st, 3rd and 19th.
June.....	<div> <div>Max...</div> <div>Mean</div> <div>Min....</div> <div>Range</div> </div>	<div> <div>29.907</div> <div>29.760</div> <div>29.552</div> <div>0.355</div> </div>	<div> <div>74.9</div> <div>93.6</div> <div>...</div> <div>62.2</div> <div>31.4</div> </div>	<div> <div>1.048</div> <div>0.741</div> <div>0.461</div> <div>0.587</div> </div>	<div> <div>100</div> <div>85</div> <div>54</div> <div>46</div> </div>	<div> <div>19</div> <div>11</div> <div>3</div> <div>16</div> </div>	<div> <div>22.94</div> <div>5.89</div> <div>0.00</div> <div>...</div> </div>	S. 39° E.	2.167	6.704	Fifteen days rain. Storms on the 5th, 25th and 27th.
July.....	<div> <div>Max...</div> <div>Mean</div> <div>Min....</div> <div>Range</div> </div>	<div> <div>29.947</div> <div>29.692</div> <div>29.104</div> <div>0.843</div> </div>	<div> <div>81.6</div> <div>97.0</div> <div>...</div> <div>67.1</div> <div>29.9</div> </div>	<div> <div>1.197</div> <div>0.935</div> <div>0.622</div> <div>0.575</div> </div>	<div> <div>100</div> <div>87</div> <div>57</div> <div>43</div> </div>	<div> <div>17</div> <div>8</div> <div>1</div> <div>16</div> </div>	<div> <div>44.58</div> <div>8.68</div> <div>0.00</div> <div>...</div> </div>	S. 26° E.	2.804	5.515	Nine days rain. One storm on the 25th. One typhoon on the 16th.
August....	<div> <div>Max...</div> <div>Mean</div> <div>Min....</div> <div>Range</div> </div>	<div> <div>29.888</div> <div>29.727</div> <div>29.400</div> <div>0.488</div> </div>	<div> <div>82.4</div> <div>96.8</div> <div>...</div> <div>64.2</div> <div>32.6</div> </div>	<div> <div>1.212</div> <div>0.947</div> <div>0.582</div> <div>0.630</div> </div>	<div> <div>100</div> <div>86</div> <div>61</div> <div>39</div> </div>	<div> <div>16</div> <div>7</div> <div>...</div> <div>16</div> </div>	<div> <div>31.19</div> <div>10.66</div> <div>0.00</div> <div>...</div> </div>	S. 48° E.	4.213	10.118	Ten days rain. Storm on the 2nd. Typhoon on the 27th and 28th.
Sept.....	<div> <div>Max...</div> <div>Mean</div> <div>Min....</div> <div>Range</div> </div>	<div> <div>30.118</div> <div>29.910</div> <div>29.682</div> <div>0.436</div> </div>	<div> <div>74.4</div> <div>88.3</div> <div>...</div> <div>60.3</div> <div>28.0</div> </div>	<div> <div>1.020</div> <div>0.711</div> <div>0.307</div> <div>0.713</div> </div>	<div> <div>100</div> <div>83</div> <div>30</div> <div>70</div> </div>	<div> <div>17</div> <div>9</div> <div>...</div> <div>17</div> </div>	<div> <div>20.65</div> <div>7.25</div> <div>0.63</div> <div>...</div> </div>	S. 68° E.	2.196	6.116	Thirteen days rain.

For the above abstract of observations I am, as on former occasions, indebted to the Rev. Father DECHEVRENS, S.J., whose kindness in thus periodically summarising a portion of his records, is unfailing.

Speaking generally, the note of last summer lay in its violent and constantly recurring atmospheric disturbances. Every month was stormy, and from May to September typhoons

prevailed on the China coast, Shanghai experiencing the effects of most, if not of all, of them. April was unusually rainy, and the weather did not clear up permanently during the entire season. The range of temperature was meanwhile very wide, nights of comparative coldness succeeding days of considerable heat, during which the air had been saturated with moisture. At Sicawei 37 inches of rain fell during the 77 wet days of the half-year. The highest temperature was registered on the 25th July (97°). So far as mere heat was concerned, the season was not trying, and it will be observed on reference to the burial return given below that but one death occurred from heat apoplexy.

BURIAL RETURN of FOREIGNERS for the Half-year ended 30th September 1881.*

CAUSE OF DEATH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPTEMBER.	TOTAL.
Small-pox	1†	...	...	...	...	...	1
Typhoid fever .....	...	...	...	...	1	1†	2
Remittent fever .....	...	...	...	...	...	f 1§	1
Pernicious intermittent .....	...	...	...	...	...	1||	1
Cholera .....	...	...	...	...	...	1 f 1 5†	7
Dysentery .....	...	...	...	...	...	1 f 1	2
Diphtheria	1|| f 1||	...	...	...	...	...	2
Phthisis universalis .....	...	...	...	...	...	1‡	1
Phthisis	1‡	2	...	...	f 1	f 1	5
Marasmus .....	...	...	...	1||	...	...	1
Cancer of breast .....	...	...	...	...	f 1§	...	1
Alcoholism .....	...	...	...	...	1	...	1
Heat apoplexy .....	...	...	...	...	1	...	1
Convulsions .....	...	...	...	f 1||	...	f 1||	2
Cerebro-spinal sclerosis .....	...	...	...	...	1†	...	1
Paralysis .....	...	...	...	...	f 1	...	1
Rupture of heart .....	...	...	...	1	...	...	1
Disease of heart	1	1‡ f 1	...	...	...	...	3
„ aorta .....	...	...	...	...	1	...	1
Congestion of lungs .....	...	...	...	f 1||	...	...	1
Chronic diarrhoea .....	...	...	f 1§||	...	...	...	1
Diffuse ulceration of intestines .....	...	...	...	...	...	f 1	1
Cirrhosis of liver .....	...	...	1	...	1	...	2
Abscess of liver .....	...	...	...	...	...	1†	1
Uraemia .....	...	...	...	f 1	...	...	1
Cirrhosis of kidney .....	...	...	...	...	...	1	1
Bright's disease .....	...	...	...	...	...	1	1
Necrosis of jaw .....	...	...	...	...	...	1	1
Accident	1†¶	...	...	...	...	...	1
Opium-poisoning	f 1§	...	...	...	...	...	1
Drowned .....	...	...	...	1†	...	...	1
Suicide .....	...	...	...	1†	...	...	1
Uncertified	1||	...	1 f 1	...	f 1	1‡ f 1‡||	6
TOTAL	8	4	4	7	10	22	55

* Not including deaths, if any, among the Catholic religious bodies.

† Not resident (12).

‡ Native of Manila (5).

§ Native of Macao (4).

|| Young children (10).

¶ Fracture of skull.

Omitting 1 suicide and 3 deaths from accidental causes, 51 deaths remain to be attributed to disease. Of these, 10 occurred among young children, and of the 41 remaining, 9 occurred among non-residents. The mortality among foreign residents past the age of early childhood was thus 32 (20 males and 12 females), as against 16 males and 3 females during the same period of 1880.

Subdividing the above figures, as I have done in previous Reports, we arrive at the following results:—

CAUSES of DEATH from DISEASE among RESIDENT EUROPEAN ADULTS, April to September 1881.

Typhoid fever	1	Paralysis	1 (female).
Cholera	2 (1 female).	Diseases of heart and aorta . .	4 (1 female).
Dysentery	2 (1 „).	Diseases of abdominal viscera .	6 (2 females).
Phthisis	4 (2 females).	Necrosis	1
Alcoholism	1	Uncertified	3 (2 females).
Heat apoplexy	1		

16 males and 10 females.

CAUSES of DEATH from DISEASE among NON-RESIDENT EUROPEAN ADULTS, April to September 1881.

Small-pox	1	Cerebro-spinal sclerosis	1
Typhoid fever	1	Abscess of liver	1
Cholera	5		

9 males.

CAUSES of DEATH from DISEASE among the CHILDREN of RESIDENT and NON-RESIDENT EUROPEANS,
April to September 1881.

Pernicious intermittent fever . .	1	Infantile marasmus	1
Diphtheria	2 (1 female).	Convulsions	2 (females).
Congestion of lungs	1 (female).	Uncertified	1

4 males and 4 females.

CAUSES of DEATH from DISEASE among NON-EUROPEAN ADULT FOREIGNERS, April to September 1881.

Remittent fever	1 female (native of Macao).	Disease of heart	1 (native of Manila).
Cancer of breast	1 „ („ „).	Uncertified	1 („ „).
Phthisis	2 (natives of Manila).		

4 males and 2 females, all of whom were resident.

CAUSES of DEATH from DISEASE among the CHILDREN of NON-EUROPEAN FOREIGNERS,
April to September 1881.

Chronic diarrhœa	1 female (parents natives of Macao).
Uncertified	1 „ („ „ Manila).

2 females.

The death returns call for but little remark, in spite of the unusually high mortality of the season. For it will be observed that phthisis accounts for six deaths, while various affections of the nervous, respiratory, circulatory, digestive and urinary systems which are but remotely, if at all, influenced by climatic conditions, contributed at least 16 more. The startling character of the figures is thus in great measure attributable to chance. The influence of chance is also evident in the disproportionate number of deaths among females (12 adults and 6 children), none of which were due to diseases exclusively affecting women. Seven deaths in the month of September were certified as caused by cholera, and these were followed by six others in October. How far climate, with its associated conditions, is answerable

for the production of that extremely acute and fatal form of gastro-enteritis which is known as cholera, and which now invariably presents itself here during late summer and early autumn, cannot be determined until means are provided whereby the facilities for observation offered by the General Hospital may be put to some practical use. Almost all the persons attacked belong to that unprotected and uncared-for class whose members in order to be properly treated during illness, must be placed in hospital. Private practice, therefore, yields hardly any opportunity for the accurate investigation of whatever may be the underlying condition, while in the actual state of pathology more or less slovenly postmortems have lost any value that they may perhaps have once possessed as aids to the investigation of disease. They serve only as delusive signs of an activity which, even conscientiously applied, would, if confined to this direction, produce little fruit, or none. Meanwhile it seems clear that, whatever be the ultimate cause of the disease, its incidence upon individuals is largely due to neglect of ordinary and obvious hygienic precautions. The occurrence of diphtheria, hitherto a very rare event in Shanghai, is noteworthy. To enteric fever but two deaths are attributed in the period under review, but later in the year four fatal cases were recorded. So with dysentery. The two cases which alone proved fatal in the April-September half-year were supplemented by three in October.

DISTOMA RINGERI AND PARASITICAL HÆMOPTYSIS.

By PATRICK MANSON, M.D.

IN the Customs *Medical Reports*, vol. xx, page 10, I called attention to a new parasite, the mature form of which had recently been discovered by Dr. RINGER in Tamsui, Formosa. I therein succeeded in associating this animal with a peculiar form of recurring hæmoptysis, common in one part at least of the Chinese Empire, which had hitherto not been understood; and I gave some particulars of a case occurring in my own practice, in which the association was apparent. At that time I was unaware that Professor BÆLZ of Tokio had been working at the same subject, and it was not until I read, in the *Lancet* of 2nd October 1880, a summary of a paper by this gentleman, that I learned that this disease had been described by him, and that it was not uncommon in Japan. Although Professor BÆLZ, in the paper I refer to, errs in calling the bodies which I have proved to be the ova of *Distoma Ringeri*, gregarinæ, yet, though I do not know the dates of his investigations, the merit of priority in the discovery probably rests with him.

In my Report I mention that in making a postmortem examination of a Portuguese dead of aneurism of the aorta, Dr. RINGER found a parasite in the lungs; that in the sputum of a Chinaman suffering from a chronic intermitting hæmoptysis, I found certain bodies I had no difficulty in recognising as the ova of a parasite; and that when these bodies and the ova emitted by *Distoma Ringeri* were compared, they were found to be identical in size, shape, colour and contents.

Of the parasite discovered by Professor BÆLZ, the *Lancet* says that it is

Met with in two forms: (1) as yellowish-brown ovoid bodies of .13 mm. long and .07 mm. wide. They have a double contour, from a translucent wall, .02 mm. thick, which in different positions appears greenish or reddish, and at the larger end is a kind of cover, at which the cyst opens. The contents consist of delicate jelly-like material, in which are imbedded three or five aggregations of smaller bodies. The latter consist (a) of spherules about twice the size of a white blood corpuscle, colourless, with sharp outlines. Around these spherules, and more or less enclosing them, is (b) a coarsely granular material scattered through the jelly, and in it molecular movements may often be seen. When the spherules have left the cyst, they show for a time the same movements, and then become invested with the granular substance, and become motionless.

These bodies, he concluded, are a stage in the development of gregarinæ, and he therefore proposes to call the disease they are connected with gregarinosis pulmonum, and the parasite gregarina pulmonum or gregarina fusca.

As the above description applied pretty accurately to the ova of *Distoma Ringeri*, and as they were associated with hæmoptysis, I concluded they were identical, and wrote to Professor BÆLZ, requesting him to send me a specimen of the characteristic sputum from Japan. He very kindly did so, and I had no difficulty in seeing that the bodies he described were identical with those I was familiar with and with the ova of *Distoma Ringeri*. Indeed, in his

letter to me the professor says that both he and LEUCKHART had already suspected they might be the ova of a distom. That this view is the correct one will receive additional and corroborative evidence in the sequel.

During the last 18 months I have made many unsuccessful attempts to find the ova of the parasite in the sputa of natives of this district. I suppose I have examined altogether about 150 individuals. Therefore it is not at all likely that the disease is common in Amoy and its neighbourhood. It is quite otherwise, however, in North Formosa, though only separated from us by some 200 miles of sea. Being anxious to attempt the development of the embryo, and despairing of finding supplies of ova in Amoy, I applied to my friend Mr. JOHN GRAHAM of Tamsui to find me some sputa. He answered my letter by sending me two bottles full of ova-laden sputum, one of which was filled by his house-boy, the other by his coolie. Dr. JOHANSEN also recently sent me six specimens of sputum, three of which contained ova in abundance; of the ova-laden sputa one came from his hospital assistant, the other two from peasants living near Capsulan, a place about 40 miles to the south-west of Tamsui. The facility with which these cases were found proves that the parasite must be very common about Tamsui; and Mr. GRAHAM'S servants, who some time ago both visited Amoy, told me that hæmoptysis, such as they themselves suffered from, was extremely common. Regarding their acquaintances, one of them said that 20 or 30 per cent., the other that 15 per cent., spat blood. Possibly these are overstatements, but at all events they show that the disease is extremely prevalent. With regard to Central and South Formosa, I recollect very distinctly my surprise at the large number of cases of hæmoptysis I used to meet with there, and have now little doubt that in *Distoma Ringeri* we have the explanation.

The geographical distribution of this parasite is peculiar, if it is the case, as seems probable, that it is rare or entirely absent on the mainland of China. We have Professor BAELZ'S authority for its existence throughout Japan. I suspect, therefore, that there is something in the soil or geological structure common to Japan and Formosa, but not present on the neighbouring continent, that determines this apparent caprice in the distoma area; and that this geological element, whatever it may be, is one necessary to the existence of the intermediary host. The distribution of similar parasites depends principally on the distribution of their intermediary hosts; this fact can easily be understood. Both Japan and Formosa resemble each other in being volcanic, and are both members of that long string of volcanic islands that, stretching along the eastern coast of Asia, includes, besides these, the Loochoos, the Bashees, the Philippines, and a host of smaller islands. I believe that extended inquiry will show that *Distoma Ringeri* exists in all of these.

Parasitical hæmoptysis can readily be diagnosed. There is a history of irregular intermitting hæmoptysis associated with a slight cough, and, in the intervals of more active bleeding, the expectoration once or several times a day of small pellets of viscid, brownish mucus. Violent exercise is apt to produce profuse hæmorrhage, and irritation of the lung in any way so as to induce coughing causes the discharge either of quantities of blood or of the characteristic sputum. At the same time there are no objective symptoms of lung disease, and the patient probably enjoys good general health. Examination of a small portion of the sputum with the microscope at once settles the diagnosis. I many times examined sputa from the

two cases I had under close observation for a considerable time, and never failed to find abundance of ova, sometimes counting as many as 20 in a single field.

The following are short notes of the two cases I refer to. I am told they are typical examples of the disease as found in Formosa.

HENG, male, æt. 31; resides in Sinhang, Tamsui, where he works as a house coolie. His family, he says, is quite healthy; his mother, aged 44, and three brothers and four sisters are alive and well. His father died at 58 of dropsy, and a sister died in childhood of small-pox. He himself is liable to ague. He was born in the town of Banka, and lived there till his 18th year; then he lived in Kelung for two or three years; afterwards he removed to Hobe, Tamsui, where his home has been for the last 10 years. He has travelled about the north part of the island a good deal; been in Tekchham two or three years ago; and eight years ago accompanied some Japanese to Khilai, on the east coast, where he resided for upwards of a month. His blood-spitting dates from 11 years ago; he was then working on the tea hills with his father, near Banka. At first he noticed when he breathed hard in carrying heavy burdens that he coughed a little and brought up mucus mixed with blood; from that time till now has spat blood more or less constantly; some days none, other days a considerable quantity. Once when pulling in a boat about two years ago he suddenly brought up over a bowlful of pure blood, but as a rule, unless exerting himself violently, he only brings up a few drops mixed with the mucus. Sometimes he does not spit for a few days, perhaps a month on end, and then the hæmoptysis recurs, to last for one or two months. He has a slight cough, but on auscultation nothing much amiss can be detected. His thorax is very finely developed. He says that he never exercised discretion about the water he drank, especially when young; used to take it from river, well, paddy-field or ditch, whichever lay most convenient, and he says that nearly all North Formosans are similarly indiscreet.

HENG lived in my house from the 14th to the 31st July, and during the whole of this time he could nearly always cough up blood or ova-laden mucus such as I have described.

HÊÔ, male, æt. 22; born and resident in Hobe, Tamsui; a house-boy. Father and mother are both dead, both of them of some dropsical affection. Until he was 18 years of age, enjoyed excellent health; then, without any obvious cause, he began to spit blood, especially after making any very great exertion. During one year, many times each month, he continued to spit blood, about an ounce at a time. He then got lighter work and the bleeding ceased, and has not recurred; but he has a cough still, and almost every day expectorates pellets of tenacious, muddy, yellowish-brown mucus. Sometimes for several days, if the weather is fine and his work is light, there is no cough or spit; but when the weather changes, or he has to exert himself, the cough and spit return. He complains of some pain about the left nipple, but the lungs appear healthy. His sputum is as described, and abundance of ova can be found in it.

When examined with the microscope, the ova of *Distoma Ringeri* are seen to be shaped very much after the fashion of a fowl's egg, with the exception that a circular operculum about half the breadth of the egg closes the broad end. On an average they measure about $\frac{1}{300}$ " \times $\frac{1}{500}$ ", but some specimens are slightly larger and others slightly smaller. There is considerable diversity likewise in shape, some being more globular than the majority, whilst others are more elongated and tapered towards the narrow end. Their colour, which, when blood is entirely absent, as is sometimes the case, imparts the characteristic brownish tinge to the sputum, is a dirty reddish brown, and appears to reside both in the shell and in the granular portion of its contents. The shell is without markings, and shows in double outline, more especially when it has been fractured by pressure. When viewed with a high power the ovum is seen to contain one, two or more well-defined, pale sarcode globules embedded in a structureless matrix containing abundance of irregularly disposed dark granular matter.

Usually one of these sarcode globules is brighter and better defined than the rest. By careful focussing they are seen to be made up of very minute granules in a state of active molecular movement. Pressure ruptures the shell at the opercular end, forcing out the contents, which resolve themselves into innumerable globules of all sizes, from fine microscopic granules to large bodies $\frac{1}{3000}$ " in diameter. The smaller particles exhibit very active molecular movements, and tend after a time to coalesce round the larger. No trace of a differentiated embryo can be distinguished. Once or twice I have seen attempts at yolk cleavage, a dozen or more elongated cell-like bodies with a bright nucleus in each occupying the whole of the interior of the egg; but never anything more advanced than this.

It is evident, therefore, that some time must elapse before an embryo can be sufficiently developed to start on the independent existence which has been found to be the first step in development in those distoms whose early life history has been studied. Reflecting that the ova are deposited in the sputum, that this affords probably their only means of escape from the human lungs, and that they are placed in it with a purpose, I concluded that by following out the destinies of a sputum I should probably be set on the right track for working out the first stage at least of the history of *Distoma Ringeri*.

When sputum is cast on the ground one of three things may happen: first, it may be eaten by earth-worms, molluscs or other creatures; second, it may dry up and mix with the soil, the solid parts of it being perhaps afterwards blown about as dust; third, it may be washed and carried away by rain into well, ditch, pond or river. I considered that if in any of these ways the ova are borne to suitable incubating media, the last is the most likely to favour the development of the distoma, and most in consonance with what happens in the case of better known species. Accordingly, I determined to imitate nature as far as I could in this direction, on the supposition that rain or water was the first agency that operated on the ova. I procured two supplies of sputum from the man HENG: one lot I placed, without admixture of any sort, in a wineglass and covered it up, keeping it for comparison and future experiment; the other lot, measuring about 1 oz. and containing many thousands of ova, I shook up with about an equal quantity of filtered well water until the mucous blood and ova were thoroughly diffused. This was divided into about equal portions between six wineglasses, and water sufficient to fill the glass was added to each. These were numbered 1, 2, 3, 4, 5, 6, and placed under a glass shade in a room where, during the subsequent steps of the experiment, the thermometer ranged between 80° and 94° F. Next day No. 1 was not disturbed, but all water, except the drachm or two at the bottom of each glass, containing the sediment and ova, was removed by means of a syringe from 2, 3, 4, 5 and 6, and fresh water added. On the following day 1 and 2 were not disturbed, but 3, 4, 5 and 6 were again watered, and so on. Thus in No. 1 the ova were washed once, in No. 2 twice, in No. 3 thrice, in No. 4 four times, in No. 5 five times, in No. 6, six times, the washing taking place at intervals of 24 hours. My notes of observations show that no development occurred in the unwashed ova; that it was delayed in No. 1, where only one washing had been performed; that it advanced steadily without much notable difference in 2, 3, 4, 5, 6, until at the end of from six weeks to two months the majority of the ova produced active ciliated embryos. A small quantity of sediment from one or more of the glasses was removed with a pipette daily, or every second day, and examined under the

microscope. Ova were always easily found. For the most part they were entangled in little flakes of miscellaneous *débris*, but from this they could easily be separated. Notes were made of the various changes as far as they could be detected; but for the first few weeks, on account of the dark granular character of the contents, it is difficult to say precisely what the different steps were that led up to the formation of the mature embryo. Great molecular activity can be detected in the paler globules for some time; then these lose their distinctness, large oil globules appear about the periphery of the yolk, and a paler mass shows in the centre (Figs. 1 to 11). In time the latter contracts, leaving the shell by a considerable space. Languid movements ensue in it; these become more active; a ciliated epithelium is developed on its surface, and an indentation at the opercular end indicates the presence of a mouth of some sort.

On the 26th day of incubation I note:—Examined some sediment from No. 3, and in it found an ovum of characteristic shape and colour with an embryo in it possessing considerable activity and plastic power. It moved vigorously in the shell, and altered from time to time the shape of its body, which for the most part was heart-shaped, a distinct depression existing at the opercular end. Contents of the body granular. No vessel visible. No cilia visible when in ovo, but on crushing the egg the ruptured embryo escapes, and its collapsed integument is then seen to be covered by long cilia, which keep in active movement for about one minute. Examined No. 4, and found several ova with active embryos of the same character. Also No. 1, but in it there appeared to be no advance in development (Figs. 12–19).

On the 28th day I note:—In all the glasses except No. 1, the ova contain ciliated embryos. If carefully expressed, the embryo retains its activity for 8 or 10 minutes after its escape. It rushes off from the egg a globular ciliated rotating ball; as movement subsides, the body elongates, and a ciliated epidermis is seen to extend from the tail as far forward as the anterior third or shoulder of the animal. The anterior part is naked, and at its apex is provided with a papilla or beak.

The body of the animal evidently lies free in the shell, the cilia motionless at this stage and directed backwards. If we watch the anterior part or head, which is always directed to the operculum, and for the most part closely applied to it, it is manifest that this is fixed in some way. By careful examination of ova at a later stage of development, I have satisfied myself that this is effected by an involution of the delicate membrane lining the shell, which here becomes continuous with the ciliated epidermis of the body; thus the neck is surrounded by a sort of collar, which keeps it a fixed point (Fig. 20). The movements of the animal during the last few days of its residence in the egg appear to be directed to rupturing this connexion, for the head is first turned forcibly to one side, then to another, expanded, contracted and jerked about, as if the little thing were annoyed and irritated by the collar restraining it. When this has been ruptured the embryo moves about in the shell, trying in an excited sort of way to escape, the cilia vibrating rapidly. Frequently, failing to force the operculum open, it turns completely round and energetically butts the opposite pole of the ovum with its head. After a time it succeeds in opening the operculum, which is either carried completely off, and may be found lying at some distance, or is thrown back, as if on a hinge.

If we rupture an ovum very carefully a week or two after the appearance of the cilia, and are successful in extruding the little animal without crushing its delicate tissues, it will

move away from the shell a short distance, its body elongating and contracting, and the cilia playing rapidly for a few minutes. Gradually all movements will cease, the body passing from heart-shape to spade-shape, the handle of the spade being represented by a minute papilla with a very fine canal, apparently opening at its apex. Now it may be distinctly seen that the ciliated epidermis does not cover the fore part of the body, only the posterior two-thirds, extending as far forward as the rounding in of the shoulder; also that the epidermis is in plates, one covering the tapered posterior end, and two other indistinct lines in advance of this, indicating that altogether there are three or four such plates or bands. Soon after extrusion the homogeneous or finely granular contents present larger globules containing actively moving granules, and as the feeble contractions of the body and ciliary motions cease, these granular globules increase in number, until finally the entire mass is made up of minute dancing micrococcus-like particles. Then the epidermic plates roll up, leaving the body quite naked, the cilia fade from view, and finally an amorphous mass is all that remains (Figs. 14-19).

If, however, we rupture the ovum at a later stage of development, or if our observations are made just when the embryo has squeezed its plastic body through the natural opening, the behaviour of the embryo is somewhat different. First, the cilia are seen to start into rapid motion, and then after a preliminary pause to rupture and separate itself from the lining membrane of the shell which is sometimes forced out entire along with it, or, apparently to consider what has happened, the animal rushes off at great speed, gyrating about after the manner of certain infusoria. From time to time it pauses, contracting itself into a perfect disc or globe, rotating rapidly on its axis, first in one direction, then in another. Anon it dashes off to a distant part of the slide, exhibiting in its course many diversities of form. When going at high speed the body is much elongated; at a less speed oval or fiddle-shaped or square; but at no time is the beak or naked shoulder protruded as long as the animal is alive and active, a slight depression on the ciliated surface alone indicating where these are retracted. Beneath the epidermis is a thick contractile layer; the interior appears to be fluid or a soft jelly, holding minute granules in suspension, and sometimes a larger bright point can be detected. No vessel of any sort can be traced. I do not know how long the animal preserves this active ciliated form. I have kept one alive in a glass cell for over 24 hours (Figs. 21-25).

Such, briefly, is the history of the first step in the development of *Distoma Ringeri*. The ova are laid into the bronchial mucus; in the sputum they are cast on the ground; by rain or other means they are carried to stagnant water; they sink to the bottom; in the course of six weeks or two months ciliated embryos are developed; when mature, these force their opercula and swim free in the water. What the next stage may be can only be conjectured. Doubtless they enter the body of some fresh-water animal to undergo further metamorphoses. Perhaps this animal is eaten by man, or possibly the parasites once more obtain their freedom, and, while still in the water, are swallowed, and thus obtain an opportunity of gaining access to the human lungs, their final destiny.

I have not spoken yet of the fate of the unwashed ova. The glass containing them was not disturbed for about three weeks. At the end of this time the sputum had decomposed, stank abominably, and had settled into two layers, one upper, more or less clear, and a lower,

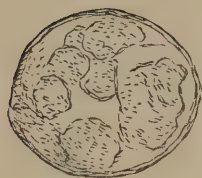
Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.



No. 1.

No. 2.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.



No. 3.

No. 5.

No. 6.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.



No. 1.

No. 6.

No. 3.

Fig. 15.



No. 3.

Fig. 16.

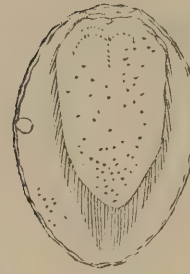


Fig. 17.



No. 2.

Fig. 18.

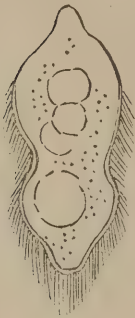


Fig. 19.



No. 6.

Fig. 20.



No. 3.

Fig. 21.

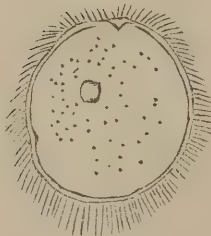


Fig. 22.



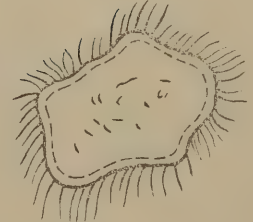
Fig. 23.



Fig. 24.



Fig. 25.



No. 3.

turbid and dark brown. On sampling the lower layer, into which the ova might be supposed to have gravitated, but few specimens could be found. These, however, were, as far as I could judge, in no way different from perfectly fresh specimens. The sputum was then washed repeatedly with fresh water. But although in the sediment ova were numerous, no decided advance in development could be detected; on the contrary, in many, signs of decomposition were apparent at the end of two months. In others, again, the characteristic globules of sarcode could still be distinguished. Thus it would appear that unless the ova are freed from mucus and have access to fresh water within a short time of their birth, they perish. If, however, water is supplied to them soon after they leave the lungs, though in limited amount, as was done in the case of glass No. 1, they do not rot, but retain their vitality, proceeding slowly in development. In the case of the ova in this glass the embryos were not differentiated till about the 40th day.

It is evident, therefore, that the ova must be brought into contact with water, and that this is the medium through which the parasite and the disease it produces pass from one human lung to another. In the history of this parasite we have another argument, if such is needed at the present day, for a pure water supply. Not many months ago there were few who would not have laughed at the idea that blood-spitting could be produced by a draught of dirty water. Now this connexion can be demonstrated. How many more diseases acknowledge impure water as one of the most important factors in their etiology, time and the advance of science will show. This matter of *Distoma Ringeri* and parasitical hæmoptysis may have little practical interest for any but some 40,000,000 or 50,000,000 of Asiatics and the few hundreds of Europeans who live among them, but it is a valuable text for the advanced sanitarians of Europe to work on and preach from; to show that to-morrow some new fact may disclose unsuspected connexions between disease and uncleanness.

By these observations the search for the intermediary host is limited to a comparatively small group of animals. It must be an inhabitant of fresh water; it is common to Japan and Formosa; it does not inhabit or is rare on the mainland of China,—at least that part of it near Amoy. The latter circumstance has precluded me from pursuing the investigation further, but I trust it will be taken up and successfully completed by someone residing in Formosa or Japan, who, being in the midst of the disease, must enjoy ample opportunity. The limitation of the field in which investigation need be made must simplify the search, but that it will be a short and easy one does not follow. The history of the liver fluke, the cause of so much disease in sheep, is not yet complete, notwithstanding the great inducements and facilities offered to its investigators in Europe and elsewhere.

On discovering the cause of parasitical hæmoptysis, the first thought that suggests itself is the possibility of curing it. Could the parasite be killed, the disease would be arrested. An important point bearing on this question has yet to be ascertained, and that is the exact site of the parasite in the lungs. Is it free in the bronchi, or is it jammed into the branches of the pulmonary artery? If the former, the parasite may be dislodged; if the latter, the prospect of cure must be very small indeed. An autopsy is necessary to settle this point, and I trust our *confrères* in Japan will bear this point in mind when they get the opportunity. The exact position of the mature parasite could easily be ascertained by microscopical examination of

bronchial mucus; the appearance of ova in a particular tube would show that the animal is to be found by following up that lead.

Proceeding on the assumption that the parasite had its habitat in the bronchi, I made several attempts in the two cases I have given to kill or dislodge it. I caused the patients to inhale the spray of solutions of various drugs atomised by a LISTER'S steam apparatus. In this way the tincture and infusion of quassia, the infusion of kousso, solutions of turpentine and santonine in spirits of wine were introduced into the lungs. In addition to these the man HENG inhaled the vapour of burning sulphur. Inhalation was practised twice daily for a week in one instance, and for a fortnight in the other. Certainly before these men passed from under my personal observation they were improved so far as cough and expectoration were concerned, but in both instances a small amount of ova-laden sputum could still be procured, irritating the lungs and inducing cough; they returned to Tamsui before I could be sure that the case was complete. In reply to my inquiries, Mr. GRAHAM wrote me lately that HENG still spits small quantities of blood at long intervals, but that HEÔ has now no cough and can no longer bring up distoma mucus. He possibly is cured.*

I am sorry I have not been able to carry further these experiments in treatment. I would not allude to them now had I much prospect of being able to extend them. I mention them only in the hope that others with opportunities better than those I enjoy will pursue the inquiry in this very practical direction.

Our knowledge of the history of the ovum and the medium in which it is developed indicates the direction which effort at prevention should take. But I fear our knowledge in this instance is a little in advance of any prevention we may look for in a Formosan. Europeans who happen to be stationed in Formosa, or who may be travelling in the island, will understand from these remarks the necessity for extra caution with regard to drinking water. They should never neglect to boil or filter it when the least suspicion is entertained about its purity. A little neglect in this matter may be paid for with a chronic hæmoptysis.

* I had an opportunity of examining HEÔ three months after the attempts at cure above described. He said he was quite well, that he had lost his cough, had spat neither blood nor mucus, and that he regarded himself as cured. I caused him to inhale irritating substances, and thus forced him to cough violently, but he failed to bring up any trace of distoma sputum. He told me that my other patient, HENG, still spat blood; and he also brought me three specimens of ova-laden sputum from three of his friends in Tamsui.

ON THE PERIODICITY OF FILARIAL MIGRATIONS TO AND FROM THE CIRCULATION.

By PATRICK MANSON, M.D.

(*A Letter to Dr. COBBOLD.*)

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Although in the paper I sent you some time ago I refrained from speculating on the cause of filarial periodicity (because I had nothing but guesses to offer), yet I have thought a good deal about what might be the reason of this most remarkable phenomenon, which, as you say, "savours of the marvellous." As Dr. MORTIMER GRANVILLE remarks, it is well deserving the attention of physiologists, for could we ascertain what the subtle influence is that sets these creatures circulating in the blood stream and arrests them with such "military punctuality," we probably would let new light in on many an obscure problem both in physiology and pathology. It was with the intention of providing myself with a standard with which to compare the results of observation and experiment that I prepared the chart I send you. If it is published it may help others, who are willing to work on this subject, but who may not have the opportunities of the continuous observation it records.

Dr. MORTIMER GRANVILLE's ingenious speculations are based on the assumption that the phenomenon of periodicity depends in some way on sleep, either on the mechanical changes in the circulation when the body is in the recumbent position, or in the different proportions of oxygen in the blood, or in relative alterations of blood and tissue temperatures during the waking and sleeping states. Now, as the embryos begin to appear hours before the usual time for repose, and are in no way sensibly affected by changes in the hours of sleeping and waking, it is evident that the power which fixes them and lets them loose operates independently of the sleeping state. It is associated with the advent of night, but not of sleep.

Part of Dr. MORTIMER GRANVILLE's note is so much to the point that I will quote it:—"The change of place may be fairly ascribed to change of state. Looking at the habits of life in the lowest organisms, it can scarcely be supposed that the periodicity can depend on the state or requirements of the filariæ. It is not likely that the parasite needs repose, or that it resorts to special localities to feed. It seems more probable that the state of the circulating fluid determines the presence or absence of the filariæ in the main current by night and day respectively." . . . The first part of this I quite agree with, but the latter part I am not quite so sure about. What is the difference between the state of the circulating fluid at 4 P.M. and 6 P.M. respectively? It is evident that something happens between these hours which liberates the embryos. I do not know that physiologists have demonstrated or even supposed some sudden change beginning in the blood between these hours. Again, the conditions permitting the free circulation of the parasites continue with increasing effect up to midnight, and the restraining influences which fix them are gradually reapplied from that time till they effect also complete fixation by 9 or 10 o'clock next forenoon. What alteration in the physiological state of the blood or body generally corresponds to these hours? If you refer to my chart you will find no explanation in the rapidity of the circulation, nor in the temperature of the body. For sometimes the pulse is quick when the embryos are numerous, and sometimes it is slow; sometimes the temperature fluctuates a degree without apparent effect on the numbers circulating.

Whatever the cause may be it certainly operates *through* the body, the medium in which the parasites are, but I very much incline to think that though operating through the body it is placed *outside* of it.

Of one thing we may be quite certain—that from the fact of the periodicity being one of 24 hours its remote cause is the rising and setting of the sun, or rather the altered relation of the earth's surface to the sun recurring every 24 hours. Of another thing we may also be certain—that the immediate cause is applied between the hours of 5 and 7 P.M. What, then, is the phenomenon in nature which, depending on the position of the earth's surface to the sun, begins to operate on the human body with the utmost regularity between the hours of 5 and 7 P.M., increases in power up to midnight, wanes towards morning, and finally ceases to act between 9 and 10 A.M.? A correct answer to this would be a step towards the solution of this strange problem; only a step, however, for the method of its operating would still remain to be explained.

We may dismiss at once the diurnal variations of atmospheric temperature and pressure, for although, especially in these latitudes, these daily ranges are pretty constant, yet when completely inverted, as sometimes happens, and as you may see from a comparison of the chart and meteorological register, there is no corresponding disturbance in filarial periodicity.

In casting about for the answer two things occur to me:—first, the rays emanating from the sun undergo about these hours marked alteration in their proportions and power; second, the magnetic condition of the earth suffers a change about the same time.

I am inclined to dismiss the former as the *direct* cause, for were the sun's rays the *direct regulating influence* we might expect to find the rhythm assumed by the embryos affected by the presence and absence of clouds and so forth. This is far from being the case, as you can see by comparing the chart with the meteorological register. The periodicity bears no relation whatever to the hours of sunshine, cloud, or rain, or other condition influencing the quantity or kinds of rays impinging directly on the human body, at least so far as I can see; but with terrestrial magnetism the case is quite otherwise. Its variations are rhythmical. If you consult authorities on the diurnal variations of the declination and inclination of the compass and intensity of terrestrial magnetism, you will find a marvellous correspondence between the rhythm of these phenomena and that of filarial periodicity. For example, the needle of the compass crosses the magnetic meridian, or mean daily position, between the hours of 9 and 10 A.M. and 6 and 7 P.M.; during the night and early morning the north end of the needle is to the east of the meridian, during the day to the west, and the hours when the meridian is crossed correspond pretty closely to the times of change from rest to activity and *vice versa* of the filaria embryos.

Again, the minimum of daily change of terrestrial magnetic intensity is between the hours of 10 and 11 A.M., and the maximum between 4 and 7 P.M., varying slightly with the season of the year. These hours correspond very closely with those of commencing rest and activity of the filaria in the normal state of the body. There is no proof whatever that there is any cause and effect relation between these two phenomena, but the coincidence is most striking, and suggests further investigation. If experiment should show such relation it would be interesting to know if the cause operated directly, or if the effect on the embryos depended on physiological changes in the body, the result of terrestrial magnetism.

These may seem wild and unjustifiable speculations, but I only offer them for what they are worth, and desire to separate them by a clear and well-defined line from my facts. But the imagination has its place in science, I believe, as well as rigid observation and induction. At any rate, actuated by these speculations, I have made one or two crude and unsuccessful experiments. I wish very much some expert in physiology and electricity would take the matter up. My knowledge is so limited, and the apparatus I can command so rude, that I despair of being able to give the answer myself. I believe a systematic examination of the compound force called light, and of terrestrial magnetism in their influence on these worms would give most valuable results, not only in solving this most interesting problem, but in opening new and fertile fields in physiology and pathology.

I do not anticipate much from observations on the disturbing effects of drugs and the febrile state. These undoubtedly in the future will be found to have an influence on filarial periodicity, and it is possible



this study may lead to just conclusions as to the cause of the phenomenon. It is not likely, however. The conditions of experiment become in such cases almost too complicated to unravel. We must be careful to bear in mind that substances or forces which interfere with the periodicity may have nothing in common with its normal cause. Assuming that quinine has this power, it would be absurd to infer that the presence or absence in the blood of this drug had anything to do with normal periodicity. It is only by the exclusion or inversion of the cause that we may hope to arrive at correct conclusions.

I have written more than I intended about my speculations on this subject. The great interest you take in these matters is my excuse, and I hope you admit it.

I will leave speculation alone now, and pass to the facts in explanation of the chart I have sent you.

The chart records a series of observations on the blood, temperature, and pulse of two Chinese lads ascertained to be filarious, and were in the main made by themselves. After enlisting them in the cause, and before commencing systematic observations, I trained them to recognise and count the embryos with the microscope, to read accurately the clinical thermometer, and to record correctly this and observations on the pulse, barometer and ordinary thermometer. I took care from time to time to satisfy myself that their observations were carefully made and recorded, and I believe if there are any errors in the chart they are few and unimportant. Observations were made every three hours, day and night, during one month. At first the hours selected were 12, 3, 6, 9, 12, 3, 6, 9; but after two days it was found convenient to change them to 1, 4, 7, 10, 1, 4, 7, 10. The quantity of blood was as nearly as possible the same in each examination, just sufficient to form a thin workable film fully occupying a covering glass $1\frac{1}{2}$ in. by 1 in. The inevitable differences in the quantities examined probably accounts in part, at least, for discrepancies in the number of embryos found at corresponding hours on different days. Notwithstanding this unavoidable imperfection, the microscopical observations serve their purpose, and in the main may be relied on. The same clinical thermometer was used throughout, and by both lads. The instrument, I found on comparing with two others, is too high set; this circumstance explains the range of normal temperature being in the 100th instead of the 99th degree as is usual.

Food of the kind usually consumed by middle-class Chinese, viz., rice, a little pork or beef, salted and fresh fish and vegetables, was taken at 7 A.M., 1 P.M. and 7 P.M., or thereabouts.

Sleep during the night was constantly interrupted to take observations, and consequently was frequently indulged in during the day.

The meteorological observations recorded in the chart were made with an ordinary large aneroid barometer, with thermometer attached. The instruments, though good enough for the purpose in hand, are probably not perfectly reliable. I have accordingly procured from the Customs a copy of their meteorological register corresponding to the period of these observations. This is very accurately kept, and may be trusted, with the exception of the afternoon readings of the thermometer. In consequence of the faulty position of the instrument they stand 3° too high during the afternoon.

Both lads come from Hooihoah, a filarious district, some three days' journey to the north of Amoy. They have resided in Amoy but a very few months. LI KHA (I. in the chart) is 21 years of age, of average size, and in good health. He has no history of fever or any serious disease. TIONG SENG (II. in the chart) is 21 years of age, and is fairly well nourished. When about 14 he had what he called ague (what I call lymphatic fever), and from that time till now has on an average an attack about once a month. The attacks begin with giddiness, weariness of the body and limbs; this gradually merges into a cold stage, with moderate rigors of two or three hours' duration; then succeeds a hot stage of very high fever of 24 hours' duration, terminating in moderate diaphoresis, lasting for an hour or two. The fever is accompanied by complete anorexia, and during its continuance the inguinal and femoral glands invariably swell up and pain him excessively, those on the right side being affected more than those on the left. Unless the attack of orchitis or inflammation of the tunica vaginalis, to be hereafter alluded to, he has

never had any trouble about the genitals or limbs, nor any signs of elephantoid disease. There is manifestly nothing of an ague type about these fever attacks. Though recurring about once a month (he had another attack without orchitis, however, on the 18th and 19th August) they are single, not quotidian, tertian or quartan.

The first three compartments on the chart refer to LI KHA (I.), the second three to TIONG SENG (II.), and the two lowest are occupied by readings of thermometer and barometer. At the margin are numbers referring to number of filaria found, temperature of body, beats of pulse per minute, etc. Along the top the figures refer to the date and the hour of the day.

One or two things require a little explanation. The effect of the *febrile state* is well shown in the case of TIONG SENG (II.). From the 12th July, when systematic observation commenced, till the afternoon of the 16th he was in his usual health, though his temperature ranged rather high, and the filarial rhythm was perfect. At 1 P.M. on the 16th, after being out of sorts all the morning, he had a rigor, followed by rapid rise of temperature and smart fever; at 4 P.M. he took 5 grains of quinine; by 10 P.M. inflammation of the right tunica vaginalis, with effusion and perhaps orchitis, declared itself, and the groin glands had become painful and swollen. Next day he was quite confined to his bed, inflammation continuing. He took three doses of quinine of 5 grains each during the day. On the 18th fever and inflammation had subsided, and he took only two doses of quinine. On the 19th the fever and inflammation relapsed, and he had an attack of a sort of convulsive hysteria; that day he had three doses of quinine. On the 20th he was better, and on the morning of the 21st was entirely free from pain and fever. The swelling of the testicle and glands gradually subsided. Contrast the behaviour of the thermometer and of the embryos during and immediately after the attacks. The disturbance in periodicity did not begin for some time after the thermometer had risen, and it continued for days after the temperature had fallen to the normal standard. My inference is that the mere elevation of temperature has not *per se* any effect on the periodicity; it would show at once were this the case; chemical or other pathological changes consequent on the febrile state have an effect, and until these changes are eliminated or subside, filarial rhythm is interfered with. The effect of the fever seems to be to prolong the periods of remission, to diminish the number circulating at the time of maximum, and prevent complete fixation at any time.

As the *quinine* taken during the attack might have had some disturbing influence, I tried the effect of a large dose on LI KHA (I.) on 26th July. 30 grains were taken in three doses of 10 grains each at intervals of one hour, beginning at 10 A.M. On the following day you see the pulse rose, the temperature fell, and comparatively few embryos could be found circulating, and their ingress that evening appeared to be delayed; but by 1 A.M. on the 28th they were as numerous as ever, and thenceforward periodicity and numbers continued as before the experiment. I cannot say, however, that this slight perturbation was the result of the quinine, for TIONG SENG (II.) was treated exactly in the same way on the 29th, but periodicity and numbers were in no way affected.

Nitrite of amyl (15 drops) was inhaled by LI KHA (I.) at 10 A.M. on the 25th. There were no embryos in the blood when inhalation commenced; shortly afterwards 2 were found in one slide, 3 at 1 P.M., 2 at 4 P.M., 0 at 7 P.M., 18 at 10 P.M.

Santonin (4 grains) was given to LI KHA (I.) at 10 A.M. on the 29th, and the same dose at 7 P.M. No effect apparent.

Turpentine spray inhaled by LI KHA (I.) at 10 A.M., 1st August. No result.

Quassia tincture spray inhaled for 11 minutes at mid-day 1st August by TIONG SENG (II.). No result.

Besides these I have tried one or two experiments with electricity, but they proved barren, and need not be detailed.

Referring again to your Quekett Club communication of 27th February, I would ask you if Dr. BANCROFT has published his observations on the dog louse as intermediary host of *Filaria immitis*?

Unless he has observed metamorphosis of the embryo in the louse's stomach it is premature to conclude that this is the intermediary host. Did the louse play the rôle he assigns to it? then we might expect to find *Filaria immitis* in the dog in all countries where the louse is found. The intermediary host is, I fancy, the principal element in determining the geographical spread of such parasites. A little reflection soon convinces one of this.

Before concluding this letter I would suggest that Dr. SOMERVILLE's statements about the habits of the Chinese with regard to the use of drinking water should not be received until he or someone else has given us the details of the investigations that have led him to the conclusion that the Chinese do not drink uncooked water. I have been many years in China and mix a good deal with the people, and the outcome of my experience is that, like other people, the Chinese drink water when they are thirsty and can get nothing better. It is quite true that with a certain class of Chinese there is prejudice against drinking cold water, but it is only the richer classes who can afford to act on such prejudices. I asked a Chinese friend, "Do your countrymen often drink cold water—the farm servants and coolies?" "Certainly," he said, "all drink water if thirsty on the hill side or in the fields; what else can they get to drink?" Only a day or two after reading Dr. SOMERVILLE's letter I asked 10 consecutive patients as they passed through the hospital consulting room about their drinking habits, and these are the answers to my question, "Do you drink cold water?"

I. Case of elephant leg, a paperhanger—Before my disease began I drank cold water daily, especially during the hot weather.

II. Case of bruise, a boatman—When thirsty I always drink cold water.

III. Case of leprosy, a boatman—When younger, and before falling ill, *i.e.*, till I was 12 or 13 years old, drank cold water in hot weather. Since my leprosy commenced never drink cold water, always tea.

IV. Case of fibro-sarcoma, farm labourer—I generally drink cold water, sometimes tea.

V. Case of bruised and lacerated lip, idol paper maker—I generally drink tea, once in 10 times drink water; when young I always drank water.

VI. Case of scabies, a comb maker—Seldom drink; when very thirsty generally drink water, sometimes tea.

VII. Case of flat feet, a blacksmith—Generally drink tea, very rarely water.

VIII. Case of leprosy, pedlar—When young I drank water daily, now generally drink tea; water seldom.

IX. Case of dyspepsia, pedlar—When young drank water; since becoming dyspeptic never take fluids.

X. Case of bruise, shopkeeper—I generally drink tea or rice water; sometimes drink water.

There happened to be nine lads, assistants and dressers, in the room when I interrogated these patients. Turning to them I asked them individually if they drank water; one and all confessed to being guilty of the habit, and seemed very much astonished that anyone should doubt it.

Foreigners are not so partial to water-drinking as are the natives; at least when water is drunk it is usually qualified with wine or spirits, and aerated waters of different kinds are in general use. The most careless foreigner and the total abstainers seldom drink unfiltered water; and if filtration cannot exclude an animal at least the thirtieth of an inch in length, the passing of water through a filtering apparatus must be regarded as a meaningless ceremony.

It is to be regretted that Dr. SOMERVILLE has not been more explicit as to the number of natives whose blood he has examined for filaria. Dr. RENNIE, of Foochow, writes me he frequently sees the parasite in his hospital cases. Readers of LEWIS' earlier papers will remember the warning he gave, foreseeing such criticisms as Dr. SOMERVILLE'S. He says, referring to accounts of chyluria cases, "such remarks as this will be frequently recorded, 'Filaria searched for but not found,'—or words to that effect.

If the examination of filarious blood is made during the night it is almost as easy to find the parasite as it is to find a white blood corpuscle. Seeing this, and the frequency with which the presence of the parasite is associated with lymphatic fever, elephantoid and other disabling affections, I have sometimes thought it would be worth the trouble for the Government in India to institute the systematic examination of the blood of native recruits by their medical officers. I am satisfied that by the rejection of filarious subjects much invaliding and expense might be avoided, and that, too, at very little trouble. At any rate, much useful information might be got together, and such an idea might be profitably ventilated by Sir JOSEPH FAYRER or some other Indian authority.

APPENDIX.

THE following reproductions of some recent papers on pathological questions which are of special interest to the medical profession in China are here brought together as fitly supplementing, and in some instances explaining, clinical facts of daily observation which existing conditions often render difficult of interpretation:—

ABSTRACT OF A PORTION OF A PAPER READ BEFORE THE INTERNATIONAL MEDICAL CONGRESS OF 1881, ON THE RELATIONS OF MICROSCOPIC ORGANISMS TO SPECIFIC DISEASES.

By Professor KLEBS of Prague.

THE general morphological law, under which every difference of form corresponds to a difference of function, and the only diversity evidenced by any single series of identical forms lies in the functional activity of its members, is as true in the case of those inferior organisms which are found in the body under pathological conditions as it is in all other cases. Observation proves that identity of parasitic form corresponds exactly to identity of pathological process.

Three groups of microscopic organisms are found in the infectious diseases which attack animals, including man. These are *hyphomycetes*, *algæ* and *schizomycetes*. These groups present as regards development varying aptitudes, depending partly on their ordinary or normal conditions of existence, but more especially on their power of adaptation, which, as DARWIN has demonstrated, is common to all living beings, and lies at the origin of the production of new species endowed with new properties.

A.—The *hyphomycetes*, in consequence of the quantity of oxygen which they require, occasion but a small number of morbid processes, whose seat is generally superficial; *e.g.*, favus, herpes circinatus, thrush.*

B.—Among *algæ* it is hardly necessary to mention more than the leptothrix, which causes concretions not only in the mouth, but in the salivary ducts, and in the bladder. The sarcina of GOODSIR may also be named. It is worth while to remark that, with respect to their morphological and vegetative relations, many schizomycetes, and particularly the group of bacilli, are allied to the *algæ*.

C.—The *schizomycetes* are, however, the organisms which account for the largest group of infectious diseases. They may be divided into two series morphologically distinct from one another, viz., *bacilli* and *cocco-bacteria*.

a. Bacilli present the appearance of filaments in the interior of which spores develop, these latter, after escaping and under favourable conditions, reproducing filaments. Much oxygen is required for the development of these organisms, and particularly for the formation of spores. There is a long list of

[* D'une manière générale, je dois faire observer que les parasites aërobies ont quelque peine à se cultiver dans le sang, tant que les globules de celui-ci sont en bon état physiologique. J'ai toujours pensé que cette circonstance s'expliquerait par une sorte de lutte entre l'affinité pour l'oxygène des globules du sang et celle qui est propre au parasite dans les cultures. Tant que les globules du sang l'emportent, c'est-à-dire s'emparent de tout l'oxygène, la vie et la multiplication du parasite deviennent très difficiles ou impossibles. Il est alors facilement éliminé ou digéré, si l'on peut dire ainsi.—PASTEUR, *Comptes rendus de l'Académie des Sciences*, 3 Mai 1880.]

diseases in which bacilli play a part :—Malignant pustule (KOCH), malarial affections (KLEBS and TOMMASI-CRUDELI), typhoid (KLEBS, EBERTH), typhus (KLEBS, unpublished observations), swine cholera (KLEIN). To these must be added the *bacillus leprosus* discovered by NEISSER. All these diseases have one character in common. They are due to influences arising more or less directly from the soil, which, however, does not exclude their transmission from individual to individual. Perhaps cholera and yellow fever should be included in this group, as our present knowledge appears to indicate that they are of telluric origin. Alongside of these general infectious diseases stand local affections indicative of the presence of these organisms in the diseased region. As an example, bacillary gastritis may be cited.

b. The second group of pathogenic schizomycetes has received from BILLROTH the name of cocco-bacteria, on the ground that it is constituted by masses of micrococci capable of transformation into short rods. Two genera may be distinguished: *microspores* and *monads*. In artificial cultures the former, needing a medium poor in oxygen, are found at the bottom of the culture fluid; while the latter, requiring a medium rich in oxygen, are found at the surface. Among the affections produced by microspores must be enumerated the septic processes and true diphtheria. To monads are due a vast series of diseases which, according to their clinical symptoms and anatomical lesions, may be classified as inflammations, acute exanthems, infecting tumours and leucocytozes. The inflammatory processes under their control are mainly those which do not commonly terminate in suppuration. Such are rheumatic affections with concomitant or consecutive cardiac, renal and hepatic lesions leading to the formation of connective tissue rather than to that of pus; croupous pneumonia; erysipelas; certain puerperal affections, and mumps. The acute exanthems belonging to this group are small-pox, vaccinia, scarlatina and measles. The infective tumours are represented by tuberculosis, syphilis and glanders.

Of all micro-organisms, cocco-bacteria are those whose presence is most difficult to demonstrate in the affected tissues. According to the ascertained seat of predilection of each organism, investigation into its biological relations should be directed in turn to animal tissues, to soil, to air and to water.

[*Memorandum.*—COHN'S process for the investigation of tissues supposed to contain micro-organisms has been adopted by HANSEN, CORNIL, SUCHARD, and MALLASSEZ. It is as follows :—The specimen is hardened in absolute alcohol and cut into thin sections. These are plunged for 24 hours into a $\frac{1}{1000}$ solution of methyl-anilin violet, after which they are found to be uniformly stained a deep and opaque blue. They are then placed for half an hour in a $\frac{1}{50}$ solution of carbonate of soda, and subsequently transferred successively through alcohol baths of increasing strength up to absolute alcohol until they are thoroughly dehydrated. By this time they are greenish, with a blue border. The next step is to immerse them in essence of cloves, which must be renewed from time to time as it becomes coloured. The moment is seized when the section loses its general tint, leaving the micro-organisms stained, while the contours of the tissue elements look as if they were suspended in a translucent jelly. The section is thereupon mounted in commercial Canada balsam.]

A CONTRIBUTION TO THE PATHOLOGY OF MALARIA INFECTION.

By Dr. B. AFANASSIEW.

(Virchow's Archiv, 1881, ii, 13.)

DURING the last war, while the Russian troops were stationed south of the Danube and in Transcaucasia, they were frequently attacked by intermittent fevers, of which various marked traces and relics persisted in many patients even after their return home. I was thus enabled, by means of the autopsies performed last year in the Nikolai Hospital, to observe alterations in various organs clearly indicative of the characteristics of chronic malarial infection. The changes in the spleen, liver, kidneys, and brain offered the following appearances:—

The spleen was enlarged, the capsule thickened and often united with surrounding structures by means of old pseudo-membranes. On section the tissue was firm and of a dark slate-grey colour. The firmness of the organ was exclusively due to hypertrophy of the areolar tissue of the trabeculæ, while the grey discolouration was caused by a deposition of dark brown pigment, disposed in granules and in heaps, which for the most part lay free in the tissue. It was, however, occasionally observed that the accumulation had taken place in the smaller vessels, whose lumen was thus crammed with black masses. Of the lymphoid corpuscles some were frequently found which contained dark brown round granules in varying amount. Many cells were completely filled with masses of the same kind, and in such cases they were enlarged to double their normal dimensions.

The liver was invariably shrunken whenever death had occurred in consequence of malarial cachexia. When malarial disease was complicated by croupous pneumonia or with any typhoid condition, the liver was enlarged, its tissue was firm, creaking under the knife, and displaying the same grey discolouration as the spleen. Microscopic examination showed a fairly uniform hypertrophy of the connective tissue between the acini as well as between the separate liver cells. In uncomplicated malarial cachexia the hepatic cells were shrunken, their protoplasm containing partly fat globules and partly yellowish-grey pigment. Cells with dark-brown pigment were extremely rare. The latter filled especially the capillaries of the liver, a fact of which one could assure oneself by the examination of pencilled sections. In one section thus prepared the filling of the capillaries with blackish-brown granules was clearly seen, while in the tissue, pigment lay free and in much smaller quantity.

The kidneys were shrunken, hard, yellow, and under the microscope exhibited distinct hypertrophy of the connective tissue between the canaliculi, chiefly in the medullary cones. The epithelium of the urinary tubules was granular, but the contours of the cells were well preserved, and only in rare cases were the convoluted tubes completely filled with granular masses, partly fatty and partly albuminoid. The dark brown granular pigment lay mostly in the form of single grains in the vessels of the cortical substance. It was to be seen somewhat more closely agglomerated in the vessels of the Malpighian bodies. But on the whole, the renal tissue contained absolutely insignificant quantities of these dark brown granular masses in comparison with the spleen and liver.

The brain was in all cases bloodless and pasty. Microscopically, it showed the cells of the grey substance in the cerebral hemispheres surrounded by wide spaces. The cell protoplasm was granular, but the nucleus was always plainly discernible. The capillaries were mostly normal, but sometimes their coats were granular, the endothelium in such cases projecting somewhat into the lumen. Pigment granules were sometimes found singly in the capillaries with granular tunics, either in the lumen or in isolated endothelial cells or in the perivascular spaces.

On the whole, tissue changes in chronic forms of malaria are expressed by the following typical phenomena:—hydræmia; connective tissue overgrowth, chiefly in the abdominal organs; formation and deposition of a special pigment in the spleen and liver. In some cases death or symptoms menacing to life may be caused by various complications which, however, are connected with the malarial intoxication.

Thus, the liver capillaries compressed by hypertrophied connective tissue and obstructed by pigment become impermeable, laying the foundation for one form or another of liver disease, which develops itself in subservience to the malarial infection. Or through the spleen causes are brought into operation which produce general peritonitis as the consequence of perisplenitis or of the softening of an infarct and rupture into the abdominal cavity. Or there may be developed in the kidney some form of Bright's disease, or amyloid degeneration; or the Malpighian bodies may be obstructed by pigmentary deposit, and death ensue with symptoms of arrested renal function. It is therefore impossible to make the occurrence of so-called pernicious intermittent fever dependent on any defined anatomical lesions. More especially would it, I think, be a serious error to attach any great weight to melanotic pigment in the origination of the different threatening symptoms which develop themselves in the course of severe forms of malaria. In all my cases, at least, though melanosis of the various organs was very conspicuous, it counted for nothing in the production of the fatal result. It is possible that in some rare instances pigment might by obstructing the vessels lead to disordered function of certain organs, but it is only exceptionally that it can be made answerable for the fatal issue. The reason why every change observed in pernicious intermittent is referred to pigment probably is, in the first place, that in anatomical investigations the pigment is the most striking phenomenon, and secondly that, even should they depend on something quite different, there is nothing easier than to explain simply by embolism the most diversely disordered actions. In proof of this let me be permitted to cite a case wherein, during an attack of intermittent fever, death occurred with severe brain symptoms.

On superficial examination of the brain it seemed natural to refer the observed cerebral hyperæmia and œdema to pigmentary obstruction of the brain capillaries. But a more careful investigation proved that pigment, although present in large quantity, could have played but a small part in producing the grave cerebral symptoms. On account, moreover, of the interest which the case otherwise offers, I take the liberty of relating it somewhat at length.

On the 23rd September Sergeant ADRIAN FEDEROFF, 33 years old, was admitted to the Nikolai Hospital. In the report of his case the following particulars were noted, among others: "The patient is unconscious, wasted and anæmic; pupils dilated; pulse irregular, intermitting; breathing superficial. He fell sick yesterday (22nd). After (23rd) a convulsion he became unconscious. Next day (24th) he remained unconscious. The temperature was increased, to the touch; pulse fuller and more regular. In the evening consciousness returned. Temperature in axilla, 38°.5. Profuse sweating during the night; but soon afterwards the temperature rose again, and the patient once more lost consciousness. On the 25th the temperature was 39°.5 and the pulse small; inability to swallow; râles in chest; eschars had formed on both trochanters. 26th September, at 1 P.M., death."

Postmortem, two days after death.—Diploe of vault, hyperæmic; pia mater much thickened, cloudy and œdematous, much serous fluid escaping on section. The brain substance was moderately injected and soft; lateral ventricles distended with serous fluid; cortex chocolate colour; vessels of base cloudy and slightly sclerosed. Lungs not adherent, parenchyma full of air, but deeply pigmented and œdematous. The heart was enlarged; its muscular substance flabby; walls thin; cavities dilated. The muscle was yellow; valves unaltered. The right side was filled with loose clots. The liver was much enlarged, its parenchyma pigmented and throughout chocolate colour. Spleen enlarged (13 inches in length), its tissue rather hard and dark slate colour. The mucous membrane of the stomach as well as of the small and large intestines presented no noteworthy alterations. There were eschars on both trochanters, each a palm broad. The organs removed at the autopsy were examined partly in the fresh state, partly after hardening in Müller's fluid and alcohol. In the former case specimens, mostly teased, were prepared by immersion in a three-fourths per cent. solution of chloride of sodium, while thin sections prepared from the hardened preparations were examined in glycerine.

It was easy to distinguish the separate vessels in teased preparations of the grey substance from the cerebral hemispheres; some were enlarged and stuffed with blood-corpuscles. There was no noticeable alteration in the structure of their tunics, but small brilliant corpuscles were sometimes visible in certain of the smaller arteries at the origin of the minuter branches.

Here and there among the contents of the vessels large round granular cells were found between the red corpuscles. In the protoplasm of these cells black pigment was seen sometimes in single granules and sometimes in heaps. Other vessels, especially the capillaries and veins, contained no red blood-corpuscles; their tunics, however, exhibited various changes. Sometimes the endothelium was greatly swollen and granular, this swelling going occasionally so far that the lumen of the capillaries was altogether obliterated. The adventitia of the venous trunks was in places infiltrated with round cells. In other cases the capillary walls presented the appearance of finely granular homogeneous cylinders in which it was impossible to distinguish either the contours of the separate endothelial cells or their nuclei. Then again there were capillaries which in some places showed varicose enlargements. In the lumen corresponding to these portions, round granular forms were piled up containing black pigment either in single granules or in heaps. Often it occurred that in one capillary vessel several granular cells were heaped up and fused together, thus forming in the lumen large thrombi consisting of a granular, dimly shining, uniform mass, hardly permitting the definition of the contours of the separate cells. Acetic acid cleared the preparation and caused the granular cells to swell slightly. As regards the single, isolated, pigment granules, they were perfectly round, nearly all of the same size, and, under transmitted light, exhibited a brownish-shining centre. Where the pigment was piled up variously formed heaps and lumps were seen. Some lumps were cylindrical, but when broken up by pressure or by the application of concentrated acids, they fell into perfectly uniform round grains, similar to those found distributed singly in the vessels. When by teasing, a vessel with its ramifications was successfully isolated, it was easy to assure oneself that the above-described changes in the capillary walls did not extend throughout the entire vessel, but were restricted to certain parts. Some vascular branches had perfectly normal walls, and contained red blood-corpuscles. Others, again, were altered only in places, and here there was invariably either heaping up of pigment, or formation of thrombi by the aggregation of white blood-corpuscles, or granular swelling of the endothelium. Like changes were found in the vessels of the white brain substance, though here, on the whole, normal vessels predominated. Thin brain-sections showed in certain places marked blood congestion. In the neighbourhood of these parts the neuroglia cells were increased in number, but in spite of the most marked vascular congestion, I could never discover a migration of red blood-corpuscles either singly or in the form of an extravasation. On the other hand, elsewhere in the same preparation, vascular congestion fell into the background, many capillaries containing absolutely no blood-corpuscles. Their walls were infiltrated with finely granular pigment, and the above-described changes could be observed in them. In every section I found swelling of the endothelium in various stages of progress, and granular degeneration of the capillaries. As regards granular pigment, this was chiefly found in vessels with altered walls, single granules, or heaps of them, lying, either free in the lumina, or in the protoplasm of the swollen endothelium, or outside the vessels in the perivascular spaces. The neuroglia itself was for the most part free from pigment, single granules being but rarely found in it. In successful sections it was not uncommon to be able to follow up a capillary for a considerable distance. It might at first be normal, and contain red blood-corpuscles. Gradually it would enlarge, the endothelium meanwhile manifestly projecting into the lumen. Then would follow a knot-shaped enlarged portion containing one or more round granular cells. In its further course the vessel either diminished to its normal diameter and appearance or assumed the form of a finely granular cylinder. The knot-like enlargements, with the round cells found within them, were at the same time the seat of the greatest deposit of pigment, which was found partly free, partly embedded in the cell protoplasm. In some cases the knot-like enlargements attained a considerable size, and were filled with a uniformly granular mass infiltrated with dark brown pigment, in which mass it was only now and then possible to distinguish the contours of the single round cells or of the swollen endothelial elements. It was mainly in the grey cortical substance that the alterations just described of the vascular walls and of their contents were most clearly manifest. In the white brain-substance they were only rarely found, yet here hyperæmia was more marked. The nervous elements of the grey substance were altered in various ways. The greater number contained finely granular cloudy protoplasm, which, however, allowed the nuclei to be distinguished. Many cells were surrounded by empty spaces of greater or less size, so as to give the impression that each cell was forcibly separated from its connexions. Comparative examinations of various other brains proved that this phenomenon is to be found chiefly in cases of cerebral œdema. In other nerve cells the protoplasm was quite granular, and the nucleus indistinguishable; the pericellular spaces were at the same time hardly visible, due probably to the swelling of the protoplasm. Here and there, nerve cells were found whose protoplasm contained variously sized granules of yellow-brown pigment, a condition not uncommon in many chronic affections of the brain substance.

The accumulation of blackish-brown pigment in the liver tissue sometimes reached colossal proportions. In each section were then found variously sized and variously shaped lumps deposited partly among the acini, but mostly among the liver cells. When thin sections were washed and pencilled a connective matrix was brought to light, in which the capillaries generally contained pigment lumps, while it was only rarely that pigment was found free in the connective tissue itself. The liver cells were enlarged and finely granular, the nuclei being not clearly distinguishable in every cell. Only a few exhibited lumps of black pigment; for the most part there was a deposit in them of variously sized yellow-brown pigment granules similar to those commonly found in cases of blood-stasis in the liver. This pigment was clearly distinguished from the dark brown melanotic pigment by the fact that the latter consisted of single, equal-sized, uniformly round granules provided with a brilliant centre. The masses arrested in the capillary lumina were in the highest degree rebellious to the action of all reagents. When firmly pressed they fell into single granules of uniform appearance and size, just as I described the conduct of the pigment in the brain capillaries. The connective tissue was increased as well between as among the hepatic lobules.

In the spleen the distribution of pigment was irregular. It lay mostly in the red pulp in the form of large, variously shaped lumps. In the trabeculae as well as in the Malpighian corpuscles it was found in small quantity, distributed in single granules or in small piles. The lymph corpuscles of the spleen were of various sizes. Many were enlarged, and contained considerable quantities of dark brown pigment granules, recalling very vividly the cells found in the brain capillaries. Others, again, were free from pigment, and presented nothing abnormal. The connective tissue was increased.

In the cortical substance and pyramids of the kidneys the interstitial connective tissue was increased. The epithelium of the convoluted tubes was cloudy and granular. The contours of the separate cells were plainly visible, only here and there tubes were found filled with a finely granular mass. The renal vessels showed no alteration, single pigment granules being but rarely found in their lumina. Accumulation of pigment was noticeable exclusively in the capillary loops of the Malpighian coils, and even there it did not occur to any great extent, and was confined to isolated regions.

These alterations of the different organs in the case just described enabled me to diagnose (so-called) pernicious intermittent fever with cerebral symptoms.

In the literature of the subject a widely varying nomenclature is adopted for the form of disease in question. According to the manner in which cerebral symptoms declare themselves during life, we have to do with "comatose," or "apoplectic," or "epileptic," or "maniacal," or "soporose," or "tetanic," or "hydrophobic," or "cataleptic" intermittent fever, and so on, without being able to link any definite anatomical changes with these denominations. Formerly the cause of the symptoms was sought for in the specific operation of blood poisoned and altered by malaria on the brain centres, and in a nutritional disturbance of the brain thereby caused. Or it was fancied that, as a consequence of blood pressure, hæmorrhages and exudations occurred which paralysed the functions of the centres. MECKEL gave a more exact explanation of the cerebral symptoms developed in the course of pernicious fever. Relying on his discovery of granular pigment in the blood of those severely stricken by forms of malaria, he called attention to the possibility of obstruction of the brain capillaries by the products of disintegration of red blood-corpuscles. He at the same time remarked that disturbances in the cerebral circulation, and capillary hæmorrhages may depend on capillary obstruction, and may thus account for the different brain symptoms noticed during life. These observations were confirmed by later investigators (especially by PLANER, FRERICHS, HESCHL, and others), and supported by a great many fresh cases. At the same time it was proved, chiefly by FRERICHS' papers, that while, on the one hand, cases occur of great pigmentary accumulation in the brain without symptoms, cerebral forms of malarial intoxication are, on the other hand, often enough observed in which there is no sort of pigment accumulation to be found either in the brain itself or in its capillaries.

Thus it came to pass that the belief in the importance of pigment and of cerebral embolism was soon seriously shaken by the attempts made to explain by them the occurrence of cerebral symptoms in the course of intermittent fever. GRIESINGER, FRERICHS, and others, relying on the disturbance of renal function, and on the discovery of a blocking of the vascular network of the Malpighian coils by pigmentary accumulation, and appealing to the alteration of the renal tissue in Bright's disease, conjectured that there

might be a causal connexion between brain affections and uræmia. Later on, LEBERT drew attention to the fact that in countries where malignant malarial fevers are prevalent, brain symptoms manifest themselves, and a fatal result occurs during the earliest paroxysms of fever, and therefore at a time when there could hardly be any question of profound blood change. These observations and the ascertained fact that cerebral symptoms of a typical kind occurring in intermittent fever are successfully combated by quinine led F. NIEMEYER to repudiate any connexion between these symptoms and obstruction of the cerebral vessels by pigment. It is, he says, possible that the poisoning of the blood by marsh miasma may cause brain symptoms contemporaneous with, but certainly independent of, accumulation of pigment. HERZ, in ZIEMSEN'S *Handbook* first remarked that although some authors are wont to link many serious alterations of organs and dangerous brain symptoms (delirium, convulsions, sudden death) with the presence of pigment in the blood, still it is not quite justifiable to derive all the brain symptoms from it, for pretty often where severe cerebral symptoms had been present, the brain was free from pigment even though the blood contained it. Further, severe nervous symptoms occur without our being able to demonstrate pigment in the blood or in other organs. Conversely, HERZ even found pigment in the tunics of the cerebral vessels, although he had not observed any symptoms of brain mischief during life.

If we now revert to the case above reported, we can see by it how well founded were the doubts of the authors just enumerated in regard to the part played by pigment in comatose fever. In that case we specially noticed that pigment deposit had occurred in the walls of those vessels wherein degeneration of the epithelial cells had already taken place in the form of swelling and granulation. Disturbances of brain function appeared at the moment when these swollen and partly pigmented cells entered the bloodstream and remained fixed in those capillaries whose tunics had in consequence of degeneration lost their contractility, and whose lumina had by the swelling of the endothelium been narrowed or altogether obliterated.

The cells obstructing the brain capillaries were most probably white blood corpuscles which had in part become pigmented and in part swollen. But as the brain symptoms, and consequently the thromboses which caused them, coincided with the access of fever, we may certainly conclude that the swelling both of the white blood-corpuscles and of the vascular endothelium occurred under the influence of malarial poison. We find, moreover, lymph-corpuscles in the spleen, whose resemblance to the cells found in the brain thrombi is unmistakable. This leads us to assume an irruption of swollen, pigmented cells from the spleen into the blood during the fever paroxysm. The brain changes in comatose intermittent fever, which I have above described, offer to my mind a satisfactory explanation of the phenomena which are not intelligible on the theory of pigmentary embolism. Hence brain symptoms are by no means necessarily to be expected whenever pigment is present in the vascular tunics and perivascular spaces, a fact already established by many writers. On the other hand, even in the total absence of pigment alike from the brain and other organs, highly developed cerebral symptoms must occur as soon as the endothelium swells and the brain capillaries become obstructed by white blood-corpuscles.

The fact adduced by NIEMEYER, in opposition to the importance of pigmentary emboli, viz., that cerebral symptoms may completely disappear after the administration of quinine in massive doses, is now readily explicable on the assumption of obstruction of the capillaries by white blood-corpuscles. It is not unlikely that quinine, when it gets into the blood, exerts such an action on the swollen vascular endothelium and white blood-corpuscles as partly to prevent and partly to remedy the collection of the latter in the capillaries, and the consequent obstruction.

I must now say a few words about the eschars acutely developed on both trochanters the day before death. Such forms of inflammation from pressure occurring in the most various parts of the body, and even gangrene of the extremities, in the course of pernicious intermittent fever, have already been described by many authors (*e.g.*, FOURNIER, SCHOLZ, LAFAYE, HERZ, etc.). So also in this disease boils and carbuncles are formed whose origin POOR explains by pigmentary thromboses of the skin capillaries. The eschars in

our case are probably to be accounted for by irritation of the nerve centres, and I am disposed to class them with CHARCOT's cases of *eschare à formation rapide* following on cerebral and spinal hæmorrhages.

Finally, let me be permitted to make some remarks on the nature of the pigment which in all the cases under my observation imparted a dark slate-coloured tinge to the most diverse organs.

All authors from MECKEL to ARNSTEIN regard the pigment, which in cases of malarial cachexia accumulates in the blood and other tissues, as a product of disintegration of the red blood-corpuscles which lose their vitality during the fever paroxysm. According to the unanimous testimony of all writers, the form and size of the separate pigment particles are extremely variable. Sometimes the particles are round, sometimes angular, their size varying from the merest point to 8 or 9 μ . In all the cases investigated by me the pigment presented a special form, and certainly bore no resemblance to the colouring matter of the red blood-corpuscles such as we commonly find it, with all its modifications, in other pathological conditions and in melanotic tumours. In particular, I never found very fine pigment granules; on the contrary, most of the granules were alike in size and in circular form, and contained a brilliant central portion, so that each presented a double contour. The lumps and masses proved on closer investigation to consist of the above-described single, uniformly circular, corpuscles. All this arouses serious doubt in my mind as to the derivation of the granular pigment of malaria from the colouring matter of the blood, and suggests the inquiry whether these forms do not arise elsewhere. Indeed, if we compare them with COHN's chromatogenous species of micrococcus, especially the species which he designates *Micrococcus prodigiosus* or *Palmella prodigiosa*, we are involuntarily led to conjecture the existence of a certain connexion between malarial pigment and these low organisms. I do not undertake to solve the question; but I consider it necessary to point out the propriety of raising it, in view of the above-described uniformity in shape and size presented by the malarial pigment, in view, too, of the fact that the origin of the latter from the colouring matter of the blood is by no means firmly established. At the same time I trust that inquiries may be directed to this point wherever the acquisition of the material thereto necessary, as regards quality and quantity, is not attended by insurmountable difficulties.

INVESTIGATIONS REGARDING THE BACILLUS OF ENTERIC FEVER.

By Professor C. J. EBERTH of Zürich.

(Ibid, 1881, i, 486.)

In a former paper (in the *Archiv* for 1880) I showed that in typhoid fever schizomycetes are found in the lymphatic structures of the abdomen (intestinal mucous membrane, mesenteric glands, spleen), which I believed might be regarded as specific typhoid fungi, as they differ in many respects from the organisms hitherto found in man. I was strengthened in this opinion by the fact that their number goes on diminishing as the duration of the disease is prolonged. That is to say, it has been proved that just in the beginning and at the height of the malady, but before sloughing has occurred, these organisms appear in the largest numbers, and that as the duration of the process extends they again disappear with the retreat of the characteristic "medullary infiltration."

Much as I should like to have brought forward further proofs of the specific character of these fungi by means of a greater number of fresh observations, I have hitherto failed to enjoy suitable opportunities. However, the 17 cases of typhoid which I now report cannot fail to prove a welcome addition to the already existent material. Moreover, I thought it right not to omit a search for indirect evidence, which, by demonstrating the absence, in the course of other diseases, of those organisms which have hitherto been found in typhoid, affords weighty arguments in favour of the specific nature of the organisms in question.

I now, in the first place, detail 11 cases of various partly infective processes.

VARIOUS PATHOLOGICAL CONDITIONS.

No. 1.—Female, aged 28. Postmortem $4\frac{1}{2}$ hours after death.

Larynx unaffected.

Thoracic organs:—Fungoid endocarditis of the aortic valves.

Lymphatic glands:—Not enlarged. Among 80 sections one capillary was found obstructed by micrococci for a short distance, and one irregular heap of micrococci lying free.

Spleen much enlarged, and contained an old infarct. Among 30 sections, two small reticulated heaps of micrococci were discovered in the infarct.

Suppurative inflammation of knee. Many micrococci in the pus. Bedsore, the skin for a considerable distance around was gangrenous, and the underlying veins contained dark red thrombi.

No. 2.—Male, aged 5. Postmortem 14 hours after death.

Larynx unaffected.

Thoracic organs:—Fungoid and ulcerative endocarditis of the tricuspid valve. Embolism of different branches of the pulmonary artery.

Lymphatic glands:—Not enlarged. Among 80 sections no coccus- or bacillus-heaps.

Spleen:—In each large section, measuring about 18 mm. \times 5 or 6 mm., there were from 5 to 15 greyish-brown piles of micrococci, some of them very large.

Kidneys:—Enlarged, pale (scarlatinal nephritis).

Skull:—Suppuration of petrous bone, fungoid phlebitis of the sinus, suppurative phlebitis of the jugular vein.

No. 3.—Female, aged 33. Postmortem 19 hours after death.

Larynx unaffected.

Thoracic organs:—A tolerably recent, but already pale, infarct in one lung. Empyema.

Lymphatic glands:—Not enlarged. In about 40 sections, no micrococcus- or bacillus-heaps.

Spleen :—Enlarged. No micrococcus- or bacillus-heaps.

Ichorous endometritis from retained placenta; suppurative, fungoid peritonitis. Many micrococci and putrefactive bacilli in the peritoneal exudation. Septicæmia.

No. 4.—Male, aged 2. Postmortem 20 hours after death.

Larynx unaffected.

Thoracic organs :—Extensive fat-embolism of the lungs. Pulmonary œdema; anæmia.

Lymphatic glands :—Somewhat enlarged. No organisms found in 50 sections.

Spleen :—Rather swollen. No organisms found in 40 sections.

Intestines :—Peyer's and the solitary glands somewhat swollen.

Extensive traumatic separation of the skin, which had occurred two days before, along with laceration of the soft parts of the left leg.

No. 5.—Female, aged 33. Postmortem 32 hours after death.

Larynx unaffected.

Thoracic organs :—Pulmonary œdema.

Lymphatic glands :—Enlarged, chiefly those of the inguinal region. The mesenteric glands were unaffected. Those of the groin contained many heaps of micrococci. Extensive inflammation of the leg caused by an ulcer on the foot. Ichorous endometritis.

No. 6.—Male, aged 54. Postmortem 40 hours after death.

Larynx unaffected.

Thoracic organs :—Focus of gangrene of the size of a walnut in the right lung. Cancer of the stomach.

Lymphatic glands :—Not enlarged, infiltrated with cancer, containing no micrococci or bacilli.

Spleen :—Not enlarged.

Intestines unaffected.

Suppurative inflammation of the knee; many streptococci in the contents of the joint.

Bedsore.

No. 7.—Female, aged 67. Postmortem 49 hours after death.

Larynx unaffected.

Thoracic organs :—Empyema, bronchitis, œdema, pericarditis.

Lymphatic glands :—Enlarged, hard; containing no organisms.

Spleen :—Somewhat enlarged; containing no organisms.

Intestines unaffected.

No. 8.—An infant of a few weeks. Postmortem 53 hours after death.

Larynx and *thoracic organs* free from important change.

Lymphatic glands :—Somewhat enlarged; slight diffuse infiltration; contained no organisms.

Spleen :—Not enlarged; free from organisms.

Intestinal catarrh.

Cholera infantum and atrophy.

No. 9.—Male, aged 44. Postmortem 56 hours after death.

Larynx unaffected.

Thoracic organs :—Chronic endocarditis of the mitral valve; recent deposits on all the valves.

Liver cirrhotic.

Lymphatic glands :—Somewhat enlarged, indurated; contained no organisms.

Spleen enlarged; contained no organisms.

Intestines unaffected.

This was a case of cured syphilis.

No. 10.—Male, aged 25. Postmortem 68 hours after death.

Larynx unaffected.

Thoracic organs :—Hydrothorax, adherent pericardium, hypertrophy and dilatation of the heart; thickening of the mitral valve; soft catarrhal hepatitis.

Lymphatic glands :—Normal; no organisms.

Spleen :—Slightly enlarged; no organisms.

No. 11.—Male, aged 28 (?); found dead. Postmortem 100 hours after death.

Advanced decomposition.

Lymphatic glands:—Small, and were therefore not examined.

Spleen:—Of normal size, containing only scanty, completely isolated putrefactive bacilli.

An epileptic who was found dead.

Of these cases some deserve particular attention.

In the first case (fungoid endocarditis), among 80 large sections taken from the unswollen mesenteric glands, a capillary vessel was only once found obstructed for a short distance by micrococci, close by a reticulated small micrococcus-heap.

In the second case (caries of the petrous bone, extensive fungoid phlebitis of the dura), the lymphatic glands proved free from cocci, either separate or gathered into heaps. The spleen, however, contained large and numerous masses of micrococci.

The third case (septicæmia from retained placenta), although yielding in the blood and various organs solitary bacilli staining with methyl-violet, showed no bacillus-heaps, either in the lymphatic glands or spleen, similar to those found in typhoid.

In the corpse of the epileptic brought in from outside, and already much decomposed (about 5 days dead), although putrefactive bacilli were found singly in every section from the spleen, organisms similar to those of typhoid were never found.

CASES OF TUBERCULOSIS AND PHTHISIS.

The rare occurrence of typhoid bacilli in somewhat advanced ulceration of the intestinal mucous membrane has proved that, although perhaps in many instances (*e.g.*, relapse of typhoid) this alteration of the membrane is favourable to the entrance of organisms into the wall of the gut, yet it does not come into consideration in recent cases. But it seemed to me to be indispensable to the completeness of the investigation into the occurrence, in the course of other diseases, of the organisms found in typhoid, to examine minutely the spleen, mesenteric glands and intestines, with reference to the presence of organisms, especially in cases of tuberculosis and phthisis wherein lung and intestine were highly disorganised.

No. 1.—Male, aged 22. Postmortem 8 hours after death.

Larynx:—Ulceration of right vocal cord.

Thoracic organs:—Lobular foci of caseation, caverns, tubercle.

Abdominal organs:—Amyloid liver.

Lymphatic glands:—Amyloid degeneration.

Spleen enlarged; "sago spleen."

Intestines:—Amyloid degeneration of the mucous membrane; in the colon a fair number of tubercular ulcers arranged in rows.

No. 2.—Male, aged 28. Postmortem 10 hours after death.

Larynx unaffected.

Thoracic organs:—Dilatation of the heart, globular vegetations. Disseminated grey induration, with cheesy deposits and caverns.

Abdominal organs:—Nutmeg liver; miliary tubercles of liver.

Lymphatic glands:—Caseous foci in bronchial glands. Mesenteric glands enlarged, caseous and calcified. Lumbar glands enlarged to the size of a hen's egg; caseous.

Spleen enlarged.

Omentum thickened, studded with many grey and ancient tubercles. Cheesy inflammation of the lumbar vertebræ. Psoas abscess.

No. 3.—Male, aged 30. Postmortem 10 hours after death.

Larynx:—Ulcers the size of lentils on right vocal cord.

Thoracic organs:—Cheesy alveolitis, slaty induration. Caverns.

Lymphatic glands:—Swollen, partly indurated, and necrosed here and there.

Spleen enlarged.

Intestines:—Many lentil-sized ulcers in the ileum, besides large clean ulcers with slaty bottom. The same condition existed in the colon. The ulcers occupied about one-third of the whole extent of mucous membrane.

No. 4.—Male, aged 24. Postmortem 3 hours after death.

Larynx unaffected.

Thoracic organs:—Cheesy lobular pneumonia.

Lymphatic glands:—Not enlarged, contained no foci of necrosis.

Spleen somewhat enlarged.

Intestines:—Caseation of follicles. Small clean ulcers.

No. 5.—Male, aged 30. Postmortem 12 hours after death.

Larynx:—A small ulcer on the left vocal cord.

Thoracic organs:—Apical induration of the lungs, with cheesy deposits.

Lymphatic glands:—Both mesenteric and inguinal glands were enlarged and caseous.

Spleen somewhat enlarged.

Intestines:—Ulcers mostly in process of healing.

No. 6.—Female, aged 33. Postmortem 23 hours after death.

Larynx unaffected.

Thoracic organs:—Caverns in apices. Caseous lobular hepatitis. Superficial (catarrhal?) ulcers of the larger bronchi.

Lymphatic glands:—Somewhat swollen, cheesy.

Spleen slightly enlarged.

Intestines:—Throughout small intestine, deep excavated ulcers.

Bedsore over sacrum.

No. 7.—Male, aged 36. Postmortem 24 hours after death.

Larynx:—Many small ulcers on epiglottis.

Thoracic organs:—Apical caverns. Indurations with cheesy deposits.

Lymphatic glands:—Slightly enlarged; necrosed in places.

Spleen enlarged.

Intestines:—Tubercular ulcers of various sizes in the small intestine and colon. Tubercular eruption on corresponding portions of serous covering.

No. 8.—Male, aged 55. Postmortem 25 hours after death.

Larynx unaffected.

Thoracic organs:—Extensive slaty induration with caseous foci.

Lymphatic glands:—Much enlarged, caseous and indurated.

Spleen moderately enlarged.

Intestines unaffected.

No. 9.—Male, aged 48. Postmortem 27 hours after death.

Larynx unaffected.

Thoracic organs:—Recent greyish-red, and old cheesy lobular pneumonia.

Lymphatic glands:—Slightly enlarged, fatty and necrosed.

Spleen slightly enlarged.

Intestines:—Many ulcers.

No. 10.—Female, aged 21. Postmortem 28 hours after death.

Larynx unaffected.

Thoracic organs:—Lobular hepatitis. Miliary tubercles.

Abdominal organs :—Miliary tubercles in liver.

Lymphatic glands not enlarged.

Spleen :—Enlarged ; infiltrated with miliary tubercles.

Intestines :—Two small ulcers in the small intestine.

No. 11.—Female, aged 30. Postmortem 31 hours after death.

Larynx unaffected.

Thoracic organs :—Caseous foci and caverns in the lungs.

Lymphatic glands :—Totally necrosed.

Spleen slightly enlarged.

Intestines :—Widespread tubercular ulceration.

No. 12.—Female, aged 33. Postmortem 69 hours after death.

Larynx unaffected.

Thoracic organs :—Cheesy lobular pneumonia.

Lymphatic glands :—Much enlarged ; extensively caseated and necrosed.

Spleen normal in size.

Intestines :—Many ulcers, some very large.

No. 13.—Male, aged 55. Postmortem 25 hours after death.

Larynx unaffected.

Thoracic organs :—Slaty induration, with cheesy foci and caverns.

Lymphatic glands :—Much enlarged, indurated and cheesy.

Spleen slightly enlarged.

Intestines unaffected.

Catarrh of stomach.

Examination of the organs wherein, in recent cases of typhoid, bacilli and micrococci were most frequently found, yielded a result absolutely negative as regards these organisms in the above-noted 13 cases of tubercular and non-tubercular consumption, although in some of them the intestinal mucous membrane exhibited advanced ulcerative destruction. It may be objected that the number of cases is too small to be of value. I think, however, that the smallness of the number ought not to enter into consideration, in view of the very extensive intestinal ulceration sometimes present. Although *à priori* we should expect that ulcers of the mucous membrane would favour penetration of the intestinal walls by organisms, and settlement of these latter in the lymphatic glands and spleen, we fail to find any germs. This is likewise the case during the ulcerative period of typhoid. It thus appears that even when loss of substance has actually occurred, altogether special conditions are necessary in order that an invasion of germs should take place from the intestinal tract.

One might expect that the serious disintegration to which the intestinal mucous membrane is subjected by medullary infiltration would be a favouring circumstance. The occurrence of bacilli in all typhoid cases wherein medullary swelling was most developed might support this view. In that case a greater number of organisms should invariably be found in the parts so infiltrated. But precisely the contrary is the fact, for I found them there far seldomer than in the lymphatic glands. If medullary tumefaction favoured in a general manner the irruption into diseased parts, of organisms existing any way you like in the intestine, one would surely find them also in the course of other processes producing similar alterations. In leukæmia, however, as well as in a case of tuberculosis with marked medullary infiltration of the follicles, I have failed, whenever the autopsy was not too long delayed, to find organisms in either the mucous membrane or lymphatic glands. Accordingly, it seems that only under special circumstances do diseases of the intestinal mucous membrane favour the migration of schizomycetes in general from the intestinal contents.

CASES OF TYPHOID IN WHICH BACILLI WERE FOUND.

No. 1.—Male, aged 60. Duration of disease 11 days. Postmortem 16 hours after death.

Larynx:—Mucous membrane somewhat injected; ulcers beginning to be formed.

Thoracic organs:—Bronchitis, croupous pneumonia.

Lymphatic glands:—Moderately enlarged, extremely hyperæmic. Medullary infiltration not thoroughly diffused; lymph sinus and follicular cords not to be distinguished from one another. No necrosis. In each section 10–20 bacilli-heaps, some very large.

Spleen enlarged to more than double its normal bulk, diffuent, containing likewise large bacilli-heaps in almost every section.

Intestines:—Marked medullary tumefaction of Peyer's and the solitary glands; no sign of sloughing.

No bedsores.

No. 2.—Male, aged 23. Duration of disease 18 days. Postmortem 24 hours after death.

Larynx:—Necrosis of the true vocal cords; tracheal croup; œdema of glottis; tracheotomy.

Thoracic organs:—Sero-purulent effusion into pleuræ; bronchitis; lobular hepatisation here and there in course of resolution.

Lymphatic glands:—Enlarged, moderately swollen, containing many large bacilli-heaps (2 or 3 in each section).

Spleen:—Enlarged, also containing a considerable number of bacilli-heaps, although not so abundantly as the lymphatic glands.

Intestines:—Slight medullary tumefaction of Peyer's glands and solitary follicles in the ileum. Immediately above the valve were some small sloughs on Peyerian patches exhibiting slight medullary infiltration. Colon unaffected.

No. 3.—Male, aged 22. Duration of disease 24 days. Postmortem 46 hours after death.

Larynx:—A few small ulcers.

Thoracic organs:—Greyish-red hepatisation on the right side; pulmonary œdema.

Lymphatic glands:—Slightly enlarged; occasional medullary infiltration, no necrosis. Among 50 large sections 5 bacilli-heaps, some of them moderately large, were found, mostly in the cortex. The single bacilli were of the same size and shape as those already found in typhoid, but their contours were more delicately marked.

Spleen:—Enlarged; in 30 large sections 5 moderately big bacilli-heaps. Here also the bacilli were wanting in the sharp limitation observed at other times. The heaps themselves at first sight resembled rather masses of a finely granular substance, which with difficulty admitted of differentiation into single bacilli.

Intestines:—Medullary infiltration, with sloughing and ulceration.

No. 4.—Female, aged 17. Duration of disease 28 days. Postmortem 46 hours after death.

Larynx unaffected.

Thoracic organs:—Compression and congestion of the lungs.

Lymphatic glands:—Slightly swollen; no necrosis. Among 30 sections 2 moderately large bacilli-heaps were discovered.

Spleen:—Enlarged. No bacilli-heaps.

Intestines:—A few bean-sized and lentil-sized ulcers with clean surface and level edges.

Perforation. Peritonitis.

No. 5.—Male, aged 30. Duration of disease 36 days. Postmortem 8 hours after death.

Larynx:—A small superficial ulcer on the left true vocal cord.

Thoracic organs:—Fibrinous pleuritis; lobular hepatisation.

Lymphatic glands:—Enlarged and injected. Tumefaction only in places still diffused. The lymph paths and follicular cords already easily distinguishable. No necrosis. Among 30 sections, each about 18 × 6 or 8 mm., 1 small bacilli-heap was found.

Spleen:—Enlarged. Contained no bacilli.

Intestines:—Ulceration of Peyer's patches, the edges still showing medullary tumefaction. Some healing ulcers.

No. 6.—Male, aged 34. Duration of disease about 43 days. Postmortem 36 hours after death.

Larynx unaffected.

Thoracic organs:—Pulmonary œdema.

Lymphatic glands:—Moderately swollen; diffuse infiltration. Among 50 sections 2 large bacilli-heaps.

Spleen:—Swollen. Among 40 sections no bacilli-heaps.

Intestines:—Swelling everywhere disappeared. Only in cæcum one lentil-sized clean ulcer.

Chronic arachnitis. Excessive development of fat.

CASES OF TYPHOID IN WHICH BACILLI WERE NOT FOUND.

No. 1.—Male, aged 23. Duration of disease 14 days (?). Postmortem 22 hours after death.

Larynx unaffected.

Thoracic organs:—Serous effusion into pleuræ. Bronchitis. Pulpy pneumonia. Anæmia.

Lymphatic glands:—Of nearly normal size.

Spleen:—Enlarged to double its normal size.

Intestines:—Swelling of the solitary follicles. Deeply pigmented ulcers.

No. 2.—Male, aged 22. Duration of disease 14 days. Postmortem 16 hours after death.

Larynx:—A small ulcer on each side.

Thoracic organs:—Pulpy pneumonia with lobular suppuration.

Lymphatic glands:—Enlarged, caseated; hyaline degeneration of the stroma, destruction of the tissue.

Spleen enlarged.

Intestines:—Marked sloughing; clean ulcers; intestinal hæmorrhage.

No. 3.—Male, aged 24. Duration of disease 14 days. Postmortem 2 hours after death.

Larynx unaffected.

Lymphatic glands:—Slightly enlarged, and here and there softened. No bacilli.

Spleen:—Enlarged. No bacilli.

Intestines:—Slight tumefaction of Peyer's patches; recent ulceration, very extensive in places. Some ulcers still covered by sloughs. Perforation.

Peritonitis.

No. 4.—Female, aged 24. Duration of disease 16 days. Postmortem 32 hours after death.

Larynx unaffected.

Lymphatic glands:—Enlarged, and much indurated in parts. No bacilli.

Spleen:—Enlarged. No bacilli.

Intestines:—Slight tumefaction of some of Peyer's patches. Ulcers in part still covered by sloughs, and in part clean.

No. 5.—Male, aged 25. Duration of disease 17 days. Postmortem 9 hours after death.

Larynx unaffected.

Thoracic organs:—Pleuritis on right side. Pneumonia. Growths on the mitral valve.

Lymphatic glands:—Moderately swollen; containing no large cells.

Spleen much enlarged.

Intestines:—Ulcers in parts clean, elsewhere covered by sloughs.

Focus of mycosis in lung, consisting of micrococci only.

No. 6.—Male, aged 20. Duration of disease 21 days. Postmortem 12 hours after death.

Larynx unaffected.

Thoracic organs:—Pleuritic effusion, greyish-red lobular hepatisation.

Kidneys:—An abscess the size of the head of a pin.

Lymphatic glands:—Moderate tumefaction; extensive necrosis and caseation.

Spleen enlarged.

Intestines:—A high degree of tumefaction of Peyer's glands and solitary follicles. Superficial sloughing; no ulcers.

No. 7.—Male, aged 35. Duration of disease 26 days. Postmortem 13 hours after death.

Larynx:—Ulcers on the vocal cords.

Thoracic organs:—Pneumonia.

Lymphatic glands:—Slightly swollen. Diffused medullary infiltration. Necrotic focus. No bacilli.

Spleen.—Enlarged. Among 25 sections, 2 small colonies of micrococci were found.

Intestines.—No glandular tumefaction. Clean ulcers. Perforation as large as a lentil.

Peritonitis.

No. 8.—Female, aged 42. Duration of disease 27 days. Postmortem 45 hours after death.

Larynx unaffected.

Thoracic organs.—Pulmonary oedema.

Lymphatic glands.—Small, no necrosis, no tumefaction.

Spleen somewhat enlarged.

Intestines.—Clean ulcers. Two lentil-sized perforations.

Peritonitis.

No. 9.—Male, aged 32. Duration of disease 30 days. Postmortem 20 hours after death.

Larynx unaffected.

Thoracic organs.—Lobular hepatitis.

Lymphatic glands.—Swollen. No bacilli.

Spleen.—Enlarged. No bacilli.

Intestines.—Slight tumefaction of solitary follicles. Commencing ulceration.

No. 10.—Male, aged 17. Duration of disease 33 days. Postmortem 18 hours after death.

Larynx.—Deep ulcers at anterior insertion of vocal cords.

Thoracic organs.—Suppuration in mediastinum, extending from tracheotomy wound.

Lymphatic glands.—Somewhat enlarged. No diffused infiltration. The follicular cords and lymph paths distinct. No foci of bacilli.

Spleen.—Enlarged, soft. Among 20 large sections, 2 micrococci-piles of moderate size, presumably originating by migration from the mediastinum. No bacilli.

Intestines.—Peyer's patches completely degenerated. Solitary follicles still a little tumefied.

Small bed sore.

No. 11.—Male, aged 26. Duration of disease 41 days. Postmortem 49 hours after death.

Larynx unaffected.

Thoracic organs.—Empyema.

Lymphatic glands.—Almost completely degenerated; containing no foci of necrosis. Among 50 sections, no bacilli-heaps were found.

Spleen.—Somewhat swollen; containing no bacilli-heaps.

Intestines.—Healing, slate-coloured ulcers.

The changes in the mesenteric glands and intestines were more recent in the cases where bacilli were found than in the negative cases, and although tumefaction was not very highly marked, still that partial necrosis of glands failed to be discovered which in the negative cases and in the later stages of typhoid was so frequently encountered. Case 6 is worthy of note, as in it bacilli were found after an illness reported to have lasted 43 days.

In all cases except the first the number of bacilli was much smaller than was reported in my former observations, which is quite in accordance with the fact already stated, that with increased duration of the typhoid process the number of bacilli present in the organs diminishes.* This diminution appears due not only to increased elimination, but to actual destruction of the organisms. Thus sometimes (and more particularly in Case 2, wherein the duration of the disease was 18 days) I found great heaps of true typhoid bacilli in the lymphatic glands, alongside of groups whose constituent individuals had altogether lost their delicate but distinct contours, and were in consequence hardly visible. Even if here and there on the surface of these colonies a withered bacillus was distinguishable, all the remainder of the heap presented the appearance of a finely granular mass of detritus. In Case 1 (duration of disease 11 days)

* In the cases now reported as yielding bacilli the average duration of disease was 26 days, as against 17 days, the average noted in the group of similar cases related in my former paper.

the bacilli were so numerous that in every complete section of a lymphatic gland not quite so large as a cherry I found from 10 to 20 piles no bigger than ganglionic cells, besides many small colonies.

Hardly differing in size or shape from common putrefactive bacilli, the organisms found could be distinguished from these latter only by their slight power of being stained by hæmatoxylin, Bismarck brown and methyl-violet. While putrefactive bacilli, whether in sections of alcohol preparations or in the dry state, stain deeply in the reagents just named, typhoid bacilli absorb little colouring matter, however long they may be left in the staining fluid. Larger bacilli-colonies appear indeed to be stained brown or blue. But when teased under a lens, whereby it is easy to isolate a large number of bacilli, these are seen to be hardly stained, or at most they exhibit a pale yellow tint not even remotely comparable with the deep brown or dark blue which putrefactive bacilli present after treatment with the above-mentioned staining agents. The intermediate substance reacts towards colouring fluids in the same way as the bacilli themselves. It is of course present in small quantity, and all the more difficult to demonstrate under the microscope, in consequence of the ease with which single bacilli are isolated by treatment of the colonies with acetic acid. Without using this it might perhaps be possible by teasing to divide a heap into smaller collections, but not to set free any considerable number of single bacilli. By employing it, however, a slight touch with a needle often suffices to separate a whole colony into its constituents.

On the other hand, when typhoid bacilli are dried on the slide they are deeply stained by methyl-violet, always supposing that treatment with alcohol has been omitted. If a little juice be removed with all possible precautions from the fresh surface of section of a medullary-infiltrated lymphatic gland during the initial stage of typhoid, and be allowed to dry in a thin layer on the slide, and if a section of a similar gland hardened in alcohol be taken, and if both be carefully treated with methyl-violet, the cells of the former will perhaps be found unequally stained, some slightly, others more deeply, but on the whole they will be stained much more deeply than the cells of the section, among which a large number will always remain uncoloured. Moreover, in the former preparation one is astonished by the great multitude of deep-blue tinged isolated bacilli lying in small groups or singly among the lymph cells. It is only under such circumstances that one obtains an accurate idea of the prodigious number of these organisms present. I have never succeeded in observing single bacilli in prepared sections of the same gland, however easily the bright-blue stained colonies might be seen. I am fully convinced that examination of dried and coloured juice from the lymphatic glands and spleen will yield much more precise results in regard to typhoid bacilli than can be expected from the investigation of sections. That hitherto I have not always employed this method I can explain by the fact that the demonstration of large bacilli-masses in the lymphatic organs of typhoid patients seemed to me more important than the demonstration of isolated bacilli. I would, however, add here, in order from the very first to set aside any doubts as to the precision of the method, that I was unable to find any organisms, whether bacilli or micrococci, in dried and stained juices from the lymphatic glands of those who had died of non-infectious diseases, provided only that the specimens were taken from fresh corpses.

In Case 1, wherein after a disease period of 11 days the size and number of the bacilli-colonies were truly extraordinary, the dried preparation contained, besides single bacilli, a very large number of double ones. Among these latter were some whose single members were only a little longer than they were broad, so that they rather resembled diplococci formed from slightly oval cocci. In no other case were these double bacilli so plentifully found.

In many bacilli one to three dimly-shining, round, spore-like corpuscles were visible, lying indifferently either towards the middle or near the ends of the rods. With the exception of these spore-like corpuscles in the interior of bacilli, I have hitherto failed to find micrococci masses in any uncomplicated case of typhoid. Only quite superficially in ulcers and sloughs have I found micrococci. This has also been put on record by KLEBS. They are found there in the company of bacilli which, exactly like the globular cocci, stain deeply in methyl-violet and Bismarck brown, and presumably are putrefactive fungi which have

wandered hither from the intestine. That they have nothing to do with the typhoid bacilli is evidenced by their appearance at a later period of the process, at a time when there is a marked diminution in the number of bacilli accumulated in the lymphatic glands.

Comparison with the typhoid bacilli described by KLEBS (*Archiv für exper. Pathologie*, bd. xii, 1880), which through a colleague's kindness I had an opportunity of studying on a medullary-infiltrated Peyer's patch from one of the Prague cases, leaves no doubt as to the identity of the organisms present in the Prague and Zürich patients. In this specimen, which had been taken from a severe case of typhoid, there were present not only the bacilli found here, but also longer and somewhat broader filaments which I had not before encountered. As up to the present no details have been published with respect to the frequency with which both organisms occur, and as no breeding experiments are on record, it is not yet certain whether we have to deal with two different forms of schizomycetes or only with two developmental stages of one and the same organism.

This problem can doubtless be solved by investigations of the material furnished by different epidemics. It will then be ascertained which forms are the most constant, whether perhaps some other organisms enter into the struggle, or whether one sole parasite originates the typhoid process. With reference to this I have already for a long time directed my attention to the diseases arising from meat consumption, wherein even the identity of the anatomical changes with those of common ileo-typhus has been called in question. Wrongly so, in my opinion, because both the symptoms during life and the postmortem signs correspond with those of enteric fever. The diagnosis of typhoid in the cases of meat-poisoning which occurred last year (1880) in Zürich was neither exclusively clinical nor exclusively anatomical. I can, however, very well imagine that in the instances just referred to a poison was in operation different from that of common enteric fever. But as yet nobody possesses any accurate knowledge in regard to it. Were the existence of such an organised poison demonstrated, in my opinion it would prove that by germs different from those which originate common enteric fever changes can be produced similar to those of typhoid.

Unfortunately, I am not in a position to give any information about the microscopic appearance of the organs in the cases of disease from meat consumption which occurred during the Kloten epidemic. Postmortem examination could be undertaken only at a comparatively late period, so that from a fear of getting complicated results I abandoned the idea of searching for bacteria.

Stress must be laid on the small number of bacilli discovered in the medullary infiltration of the intestine in the Zürich typhoid cases as very remarkable when compared with the great number present in some of the Prague cases. This may, I think, be explained by the longer duration of the process in my patients, as contrasted with some cases observed by KLEBS, which ran a very acute course. It is also conceivable that in the latter the infection was more virulent than in the former. If at first the bacilli are localised in the intestinal mucous membrane, the lymphatic glands will remain unaffected in the initial stage, and, on the other hand, supposing that there be no fresh infection, in proportion to the distance whereto the bacilli spread from the mucous membrane their numbers in it will diminish while they are making their appearance in increased quantity in the blood-vessels and lymphatics of the intestine, and in the lymphatic glands.

PATHOGENIC BACTERIA IN DRINKING WATER DURING TYPHOID
EPIDEMICS.

By J. BRAUTLECHT.

(Ibid, 1881, ii, 80.)

In specimens of drinking water which in the opinion of experts was to be regarded as the cause of partial epidemics of typhoid (*e.g.*, at the Brunswick gymnasium in 1877, at Dölme on the Weser in 1879, etc.), I have repeatedly found a specific pathogenic bacterium belonging to the species *Bacillus*.

When such a water, containing bacilli, delicate filaments, and cocci and cocci-heaps related to them, is left standing for 48 hours, at a temperature of 37° to 40° C., in glasses plugged with cotton, an iridescent scum forms on the surface consisting of an accumulation of similar organisms often mingled with calcium carbonate. This can be easily removed, and transferred to a suitable fluid for further cultivation. I use for this purpose a 3 per mil. solution of gelatine in well-water, to which, after boiling, 0.25 of ammonium phosphate has been added. This is kept at a temperature of 35° to 40° C. If the water does not at the same time contain too large a number of other bacteria, and if only those flakes are selected for further culture which generally present themselves in the first crop, then very soon, and often in the next crop, unmixed growths of the bacilli in question are found, which on the first transfer, as is already known, grow in general slowly in the form of white flakes at the bottom of the fluid. Succeeding crops, at the expiration of 48 hours, commonly form abundant masses on the surface, consisting of whitish and, later on, yellowish-white mouldiness. Examined under the microscope, the flakes of the first crop consist of a tangle of delicate filaments here and there more or less distinctly segmented, and soon falling apart into short bacilli, which then break up into cocci loosely hanging together like a string of pearls. In this condition they either form large heaps or still further divide, coming under observation as single cocci or in small groups. In subsequent cultivations the longer filaments soon completely disappear, and short bacilli are alone visible, of various lengths, and undergoing transformation into cocci as just described. It is clear that bacilli again form from these cocci, but I have hitherto been unable to observe with complete accuracy the mode in which this is effected. I would, however, deny a process of budding from one side of the spore (as which each coccus should probably be regarded), the capitellum remaining meanwhile attached in a manner similar to that observed in the formation of other bacteria. I am of opinion that the bacillus is formed within the spore. This swells and becomes oval, and the bacillus emerging increases in length in both directions. Spontaneous movement is absent from all stages of growth. I would not, however, positively deny that, under certain conditions, which I have not yet minutely investigated, this motion may occasionally occur at the period of the evolution of the bacilli from the cocci.

Accurate measurement of the diameter of the filaments and bacilli, though very desirable as affording means of distinguishing them from some otherwise similar pathogenic species, has hitherto proved impossible. They are about as big again as the bacilli of septicæmia delineated by KOCH, and about once and a half as big as the pathogenic bacilli from the urine of typhus patients, which I have repeatedly demonstrated, and which appear to be constantly present in that condition. They are nearly half as big as *bacterium termo*, while *bacillus subtilis* is at least three times as big.

A very remarkable distinction between them and many other chiefly innocent kinds is furnished by their conduct in the cultivating fluid. These bacilli, like some other pathogenic varieties, fail to exhibit that strong reducing power which is characteristic of many bacteria—for instance, *bacterium termo*—and several bacilli, such as *bacillus subtilis* and others, which are not rarely found in well-waters subject to

influx from open surface-drains, and to which, as well as to their cultivation products, no pathogenic properties are assigned. The innocent varieties readily reduce the nitrates in water or in cultivating fluids to nitrites, while the others, even after prolonged contact, are totally unable to do so. This can easily be demonstrated by the well-known and delicate reaction with iodide of potassium, starch paste and sulphuric acid.

Moreover, in unmixed cultivations that disgusting stench is absent which accompanies even small quantities of bacterium termo. Though development may be vigorous, the smell is not unpleasant. It is similar to that of boiled milk.

When the crop is unmixed, the reaction to litmus paper is neutral, neither alkaline, as is the case with bacterium termo, nor acid, as with others. The distillate is, however, strongly alkaline, forming a cloud in the presence of hydrochloric acid, and a distinct deposit with NESSLER's test. Provided that only small quantities are employed, and that distillation is conducted quickly, the first portions of the distillate contain a fever-producing substance which by prolonged boiling, or after a few days' exposure, loses its activity.

A non-volatile body is moreover formed in the gelatine, which quickly decolourises free iodine, but which does not make its appearance during the decomposition arising from spontaneous invasion of bacteria.

The sensitiveness of the bacilli to acids is very marked. In a gelatine solution which barely reddens litmus paper no development takes place, while an alkaline condition also disturbs the growth, though not in such a decided way.

The formation of bacilli in well-water containing sufficient nutritive material is at ordinary temperatures a very slow process, and hardly discernible by the eye. However, from apparently perfectly transparent water, and without using the sediment, I have, after nine months, succeeded in cultivating bacilli such as I have described, with all their special properties, including their pathogenic powers. Later on, after about twice that interval, the capacity for cultivation seemed to disappear. Scum removed from the water, and that kept in contact with the water, behaved in a similar way, while mouldy masses which I had left to dry on glass retained, after the expiration of three years, their power of development, and were still pathogenic.

These bacilli, with all their characters as enumerated above, and their pathogenic action which has yet to be described, can be demonstrated not only in such suspicious waters, but also very easily and in great quantity in the urine of typhoid patients. During the height of the fever, cocci are for the most part found in it, but bacilli and filaments are also sufficiently plentiful. A faint urinary smell which persists in the early cultures, and a very slight alkaline reaction, depend probably on the presence of small quantities of micrococcus ureæ, and disappear later on.

Green algæ putrefied by midsummer heat, having recently been gathered in a place perfectly free from infection and subsequently kept in a place where the same condition prevailed, proved a further source of these bacilli. This seems to me to afford proof of their spontaneous origin, that is to say, of their transformation from other kinds. They were here found in the shape of a yellowish-white mouldy layer, as thick as the back of a knife, on the surface of the pultaceous heaps of weed which had fallen into rank decomposition. Cultivation, and experiments on animals, proved their identity with the form just described. When, without cultivation, they were injected into a rabbit they produced a degree of necrosis of the intestinal glands so severe that neither before nor afterwards did I ever reach it by the use of cultivated bacilli derived from no matter which of the three sources indicated. Unfortunately, I have hitherto failed to obtain suitable material for the decision of the conjecture, which, however, is probably true, that the bacilli lose their vigour by cultivation.

Before detailing my infection experiments I wish to mention a fact which must be borne in mind in order to secure success. Occasionally, sometimes sooner and sometimes later, a bacillus makes its appearance in the cultures, whether these are derived from the water, from urine, or from decomposing algæ masses, which is as broad again, or thereabouts, as the bacillus under consideration, but which agrees with it in morphological development and in its conduct towards the culture fluid. It does

not, however, possess any pathogenic property, or at least not a strongly marked one. Although I am unable to adduce satisfactory proof of my opinion, I am disposed to regard these larger bacilli not as an accidental complication, but rather as a particular vegetative form, which as soon as it presents itself in large quantity, renders the cultivation unfit for infection experiments.

If a subcutaneous injection of $\frac{3}{4}$ to $1\frac{1}{2}$ cubic centimetres of a bacillus culture which is just beginning to form a plentiful scum be administered to rabbits, a rise of temperature of from 0.5° to 1.5° C. occurs about three-quarters of an hour later. This persists for from 18 to 36 hours, when there is a return to the normal, or a fall to 0.3° below it. Notwithstanding an ample supply of food, which is consumed in sufficient quantity, the rarity of diarrhoea, and a fever-free condition, the animals lose weight progressively, and die slowly, wasted to skeletons, sometimes after two, but more generally after from four to eight weeks. The course of events is different in very young animals (four to six weeks old). In them profuse diarrhoea sets in after two or three days, bringing on a fatal termination in a couple of days more. Here, postmortem examination reveals only intense hyperæmia of the whole digestive tract, with numerous ecchymoses, and small dark-bordered erosions of the stomach and intestines. In older animals an intensely catarrhal condition of the small intestine is constantly found, along with a generally well-marked enlargement in length and breadth of the darkened spleen, which as regards its thickness is less affected. There is invariably notable swelling and discolouration of the mesenteric glands, especially of the mass which lies between the extremities of the small intestine and cæcum. This is enlarged to more than four times its natural size. The small intestine is more or less vividly injected; in most instances it is cloudy along its entire length, this cloudiness being only scattered in less serious cases; its appearance is milky and in places pale red. Food is found only in portions corresponding to unclouded patches, if such are present, with a more naturally shining surface. The intestinal walls are thickened and easily torn; the mucous membrane markedly swollen, coloured red here and there, not rarely exhibiting irregular protuberances elevated above the level of the remainder. Corresponding to the cloudy portions of the intestine, Peyer's patches are, in the most various stages of the tumefaction, yellow, reticulated and infiltrated with medullary matter. Sloughing is, however, rare, and when it occurs it is, with few exceptions, limited to a few glands of a patch in which brownish-green or dark blue puncta of the size of a pin's head, or even smaller, are disseminated. Among 69 cases which I observed during one period of experiments lasting three and a half years, I only once observed an instance of generalised glandular destruction. As a general rule, the long gland at the end of the cæcum is affected in the same way as the glands of the small intestine. In other respects the cæcum, resembling in this the large intestine, but very rarely shows evidence of having been drawn into a share in the disease process. In both, however, the occurrence of trivial ecchymoses is left out of consideration. The heart is almost always pale and of a withered appearance; the lungs are only rarely hepatised or hypostatically congested. Œdema of the pale but otherwise intact lung is the rule. Gangrenous inflammation does not occur at the point punctured for the injection, nor do abscesses form, or if they do, they are very exceptional and of small size. In convalescing animals, however, abscesses which spontaneously burst do occur in the neighbourhood of the sexual organs or about the lower half of the head.

Nearly identical results were obtained after injection of the mouldy masses produced by cultivation, which were as far as possible freed from attached fluid.

Infection by the stomach is extremely uncertain, but I have succeeded in a few perfectly conclusive instances. In these initial diarrhoea occurred, but in other respects they manifested nearly the same symptoms and followed the same course.

By continued culture in the way above indicated, the pathogenic power of the bacilli is materially diminished. After a few cultivations, young animals no longer present that violent and rapidly fatal diarrhoea; they die later, and all their symptoms resemble those above described in the case of adult animals. The latter, although it is true they become ill, recover frequently after four weeks of sickness, especially if they are very strong. In this case they are, so far as my experience goes, proof against further

infection, so that injections which would be fatal to other animals produce in them merely a disorder passing away in a few days.

Without entering on a minute discussion of the tolerably obvious theoretical and practical inferences derivable from the observations here in the briefest manner detailed, I may be permitted to make the following remarks. If it be conceded that the widespread epidemics which I have mentioned at the beginning of my paper, and to which in the course of time other instances less remarkable have been added, were really produced by the implicated waters, the connexion between typhoid diseases and the bacilli found in water is very close. I will, particularly with regard to the Brunswick gymnasium case, endeavour on a suitable occasion to demonstrate this with a degree of probability bordering on certainty. Even sceptics will be unable to deny the fact that although well-waters are frequently found containing perfectly harmless bacteria, there are also some containing pathogenic bacteria, which, when injected into rabbits, produce symptoms similar to those of typhoid, and are easily distinguished from many others by their behaviour in cultivating fluid. It is possible that the bacterium is only a variety which is all the more stable the longer it develops itself under the influences which produced it, and all the more variable the sooner its vegetative conditions alter and the more diverse those conditions are.

Lately, KLEBS and EBERTH have demonstrated bacilli in the intestinal and mesenteric glands in typhoid cases. It may perhaps prove possible to cultivate them also and to compare them with those described by me.

CONTRIBUTION TO THE ETIOLOGY OF LEPROSY.

By Dr. ALBERT NEISSER, Privatdocent at the University of Leipzig.

(*Ibid*, 1881, ii, 514.)

* * * * *

I.—ON THE PRESENCE OF BACILLI IN THE ORGANS.

ALL the pathological products encountered in the course of leprosy indicate with certainty, so far as the cases which I have investigated go, the presence of a single, well-defined and presumably specific bacillus-form peculiar to the disease. This organism is found in the neoplasms of the skin and of the mucous membranes of the mouth, palate and larynx, in the interstitial tissues of peripheral nerves, of the cornea, of cartilage and of the testicle, and moreover in lymphatic glands, the spleen and the liver.

According to our present knowledge, lepra bacilli are not to be found in the spinal cord or in the muscles, and they have no share in producing either bullous eruptions of the skin or joint affections, symptoms none of which can be regarded as primary, but which must, on the contrary, be classed as secondary changes, probably of a trophic nature depending on nerve lesions.

A.—In the *skin*, bacilli are found alike in the circumscribed tubercles and in the diffused infiltration which, for example, invades the whole face in a more or less uniform manner. The material for investigation was obtained in part from dead subjects and partly by excision from patients. It was then hardened in absolute alcohol.

In almost every instance the bacilli lay within those large, round lepra-cells described by VIRCHOW, which, separated from one another only by a fine network of connective tissue fibres, were closely pressed together. These cells, which are often about five times the size of a pus corpuscle, contain from 1 to 12 large clear nuclei remarkably like those of epithelial cells, and very often presenting the appearance of being unsymmetrically crowded towards one side of the cell.

The bacilli and their offspring are either uniformly distributed so as to pervade the entire mass of cell protoplasm, or (more commonly) several small circumscribed collections are found, in which bacteria to the number of six or seven are arranged endwise to one another. Sometimes, also, two or three of these groups lie end to end, producing the appearance of a long thread, which, of course, is not straight. Or the agglomeration of bacilli in all directions produces a heap so compact that only by minute examination is it possible to make out that it is composed of invading organisms. Notably one always finds in these cells not only slender, smooth bacilli, but an abundance of short bacteria and finely granular particles, to the special importance of which we shall later on have to refer.

In correspondence with the varying number and form of bacilli masses deposited in the cells, each cell also varies in size and chemical composition.

It has already been stated that the cells of lepra tumours invariably exceed in size white blood corpuscles or lymph cells, as whose descendants we now with even greater certainty than formerly consider lepra cells. I shall subsequently be able to prove conclusively that under certain circumstances (bacillus invasion) white blood corpuscles can produce forms differing in no respect from real lepra cells. Meanwhile, their origin from fixed tissue elements must not be regarded as impossible, although it still awaits strict demonstration. Examination of the infiltration itself affords nothing conclusive in respect of this question.

The deepest cell stratum, that is to say, the layer situated in the subcutaneous connective and adipose tissue, contains, besides many unchanged lymph cells, the youngest and smallest tubercle cells, enclosing relatively few bacilli in their protoplasm. To make up for their small number, however, they furnish us with a predominant number of specimens, either well preserved or in actual course of formation. Gradually advancing upwards, the cells increase in size and contain several nuclei, but never reach the condition of true epithelioid or giant cells. The protoplasm always remains more cloudy than in these last-mentioned forms. The oldest layers touch a stratum of sub-epidermic connective tissue dividing the infiltration of the corium from the plane epithelial stratum, which, deprived of its downward protruding rete-prickles, is, though otherwise normal, deeply pigmented.

This uppermost layer contains a disproportionately large number of peculiarly large, round, sharply-defined heaps, which when unstained present a marked waxy brilliancy, while, on the other hand, they assume an almost homogeneous deep colouration in anilin dyes. There is some difficulty in explaining the occurrence of these "globi." In particular, when we examine under low powers unstained or carmine sections wherein the lumps are either very brilliant or (as often happens) are set with radiating margarine crystals, or stand out as yellow heaps from the red background, we might at first believe that we had before us a cross section of adipose tissue, so numerous are these spherical bodies among the meshes of a fine connective tissue fibrous network. Should the spheres fall out of the sections, the cavities left behind are all the more deceptive. This appearance, however, shows itself to be erroneous. For it is precisely the panniculus adiposus which contains such heaps in the smallest number, and then not in the proper adipose tissue, but in the connective meshes which divide the several fat lobules from one another.

The supposition that in these forms we have to do with ectatic lymphatic vessels stuffed with bacillus-thrombi is still more seductive. For, as already remarked, they lie distinctly limited in hollow spaces which are just as clearly defined. Indeed, the discovery of awl-shaped endothelial nuclei adherent to the walls points to the occasional reasonableness of this idea, while, however, the shape of the gaps as well as of the heaps, which is invariably round and never groove-like, bears certain testimony against the lymph vascular character of the forms in question.

And, finally, anilin preparations show that globi consist of cells which are particularly densely stuffed with bacilli and their products, and have been brought into a state of degeneration. The formation of spaces is only apparent, and is probably due to retraction of the cell from its fibrillary environment during the process of hardening. Bacilli increase within a cell so long as the space it affords, and its nutritive conditions, permit. Thereupon molecular disorganisation of the bacteria begins, with the formation of a granular detritus, which, moreover, is capable of being stained, and whose uniform distribution mainly accounts for the uniform colouration of the tissue. This latter has, however, meanwhile undergone a chemical change, which shows itself, so far as staining is concerned, by an increased power of fixing gentian violet. I have not been able to produce the "distinct nuclei- and bacteria-colouration" which in other cases can always be obtained. The protoplasm always shared in the staining, though with, it is true, a reddish tinge quite distinguishable from the pure blue of the nuclei. This fact is of great importance during examination with a low power, when the redly shining spheres stand out beautifully from amid the blue infiltration. When I describe the process of eosin staining I shall have to note analogous facts.

The final issue of these cells (which, by the way, are very long-lived) is first a breaking down of the bacilli infiltration with preservation of the protoplasmic base. Later on, or through the operation of some special cause, such as an acute dermatitis, both cells and bacilli are destroyed. In the former case vacuolation, which has long occupied investigators, gradually becomes prominent, the above described arrangement of the bacilli in small isolated heaps being the necessary preliminary to its occurrence. That is to say, if the bacilli disintegrate slowly, with formation of granular detritus as an intermediate condition, and then disappear from the cells, this occurs by heaps, and there remains a large nucleated pale cell in which, when not stained, the former clearly defined situations of the bacilli heaps stand out

as clear spots, while colouring distinctly indicates the intervening borders. The cell, in fact, then resembles a heap of red blood-corpuscles whose limiting membranes have alone remained visible. The presence of transitional cell forms which have lost but few of these heaps, and consequently contain but a small number of vacuoles, as well as the varying size of the vacuoles, proves beyond doubt that the explanation now offered is the correct one, while my former assumption of a taking up of red blood-corpuscles by the lepra cells was erroneous. Hæmorrhage and the formation of pigment, with deposition of the latter between the cells and in the interstices of the connective tissue, play an important part only in the final stages of lepra processes, when the blood-vessels which in large numbers traverse the infiltration, and the infiltration itself,—that is to say, the cells and bacilli,—all alike perish. Nucleus disorganisation often preludes this event.

Besides large lepra cells, small connective tissue cells, now and then infiltrated with bacilli, are seen in rows traversing the infiltration, and then generally forming spindles of somewhat larger size than usual. Small cells, indistinguishable from “wandering cells,” are also found. These are free from bacilli.

Active or mother cells are numerous, particularly in the deep layers of infiltrated connective tissue, and in the tissue tracts mounting up between the lepra colonies. The leprous infiltration itself is almost free from them.

I cannot avoid noticing a fact which is not yet intelligible to me, namely, that in some rare instances the number of bacilli was trivial in comparison with the degree of cell infiltration. It was perhaps due to faulty preservation, which indeed very seriously affects staining, or to the occurrence of non-leprous new growths, in a patient suffering besides from leprosy. It is true that no specimen was free from bacilli, but there seemed to be a strange disproportion between the quantity of new growth and the number of bacilli. For, on the other hand, in by far the greater number of specimens the marvellous multitude of bacilli present did not leave the slightest doubt as to the decisive part they played in the occurrence and character of the processes in question.

In opposition to what I formerly advanced, I must now admit that the discovery of bacilli free between the cells in the connective tissue tracts is very uncommon.

I have never yet been able to demonstrate bacilli with certainty in the blood-vessels. The whole arrangement of the infiltration, however, follows the direction of the framework of the ascending blood and lymph channels. Horizontal and oblique sections especially bring into clear relief this interdependence of the vessels and the cell masses which enclose them cylindrically, while the smaller vessels coursing through the centre of the infiltration have no particular influence on its distribution. In subcutaneous adipose tissue this distribution follows the arrangement of the lobules.

The sweat- and sebaceous-glands are not primarily involved, and at most suffer only in consequence of the disease of the vessels and periglandular connective tissue. As regards the progress of alopecia (which, by the way, is limited to particular regions) I can give no information, for in all the material at my disposal atrophy of the follicles had already been fully established.

So also I have enjoyed but one opportunity of studying recent skin changes. From it I learned that absence of the papillary substance and of the rete-prickles should indicate a terminal condition. For in the tubercles there found the rete-prickles were visible as exceedingly exuberant protrusions deeply penetrating the corium, which was infiltrated with large round cells. Here also bacilli were present in large numbers and in excellent preservation.

B.—The phenomena attending affections of the *buccal, pharyngeal and laryngeal mucous membranes* correspond so exactly with the descriptions given of the condition of the skin that details regarding them would simply take the form of a recapitulation. All that I find specially emphasised in my notes is the number and size of the globi and the enormous number of beautiful mother cells present.

C.—Examination of the laryngeal mucous membrane further showed that the *epiglottis* and *thyroid cartilage* had undergone invasion by bacilli. From the perichondral connective tissue, whose slightly

enlarged spindle-shaped cells contained a multitude of bacilli, it was possible to follow chains of round cells, always infiltrated by bacilli, between the cartilage cells along the processes penetrating the cartilage. Free bacteria were, moreover, found in these connective tissue processes. In the thyroid, whose perichondrium had been invaded by bacilli, only free organisms had wandered into the substance of the cartilage, where they were finally visible in the interior of the corpuscles near the nucleus. Even here small globi had been formed. In these preparations the intermuscular connective tissue of the larynx also contained bacilli and globi.

D.—The forms found in the *cornea*, which was rendered cloudy by the invasion of lymph cells spreading from the border towards the centre, presented the greatest similarity to those discovered in the cartilages. All these lymph cells contained delicate bacteria, and some isolated individuals were seen intruding between the corneal layers.

E.—I was able in three new instances to confirm the occurrence of bacilli in large numbers in the *testicle*. In this group of cases I did not find organisms in the interior of the spermatic tubules, but they were present in the intertubular tissue. Once also I found them in the epididymis.

F.—Cells containing bacilli were likewise found in the interacinous connective tissue of the *liver* in a case of recent interstitial hepatitis.

G.—I have not lately examined the *spleen*. In my Norwegian cases, however, I described bacilli colonies as occurring in little heaps in connexion with large cells, and deposited in the neighbourhood of the follicles.

H.—Many *lymphatic glands* showed very widespread and dense bacillus-infiltration in the peripheral zones, wherein also blood pigment was largely accumulated. The interfollicular passages especially contained large, many-nucleated, polygonal cells enclosing bacilli.

I.—In a piece of *lung*, cheesy necrotic foci were found, free from bacilli. Many long chains of bacteria were present which had wandered in after death.

K.—Most especially important, however, is the discovery of bacilli in the *peripheral nerves*, inasmuch as it classes with certainty under one pathological lesion, the tubercular and anæsthetic symptoms which have hitherto been clinically separated, and instantly explains the surprising variety of form presented by the disease. In most of my early nerve examinations my attempts to fill up the gaps in our knowledge had been fruitless, for I had always had before me old cases in the final stage, with sclerosis of the interstitial connective tissue and atrophy of the nerve fibres. After the experience gathered from investigation of the skin, it is unnecessary to dwell on the additional fact that the bacilli finally perish. Guided by their resemblance to those yellow masses in the testicle which are recognised as bacillus piles, I had already stated in my first publication that the "yellow masses" which I saw along with Professor HEIBERG of Christiania, and which simply correspond to the globi, were agglomerations of bacilli. By the death of a leprosy woman from some intercurrent malady, I have lately enjoyed an opportunity of examining nerves at an early stage of the affection, and of thus establishing the identity which exists between the interstitial changes in the peripheral nerves and the leprosy neoplasms in the skin. I was also able to ascertain the presence of bacilli in the large cells which had penetrated between the nerve fibres and bundles.

In the *spinal cords* which have hitherto been examined, though in rather an incomplete way, distinct circumscribed foci were found, which had led to destruction of nerve substance. But I am not yet in a position to say anything as regards the character of these foci. At all events, I consider it most probable that all the anomalies recognised as forming the complex of symptoms in anæsthetic leprosy should be referred to a primary interstitial lesion of the peripheral nerves caused by bacilli. These anomalies include disturbances of sensation, muscular atrophy with proliferation of nuclei and formation of interstitial connective tissue and fat, eruption of pemphigus bullæ, and mutilating affections of the joints.

II.

In preparations hardened in alcohol but unstained, bacilli are not at the first glance visible. They are to some extent brought into view by free application of acetic acid, yet still so dimly that I am convinced they would have escaped me but for my previous knowledge that they were certainly present. Treatment with potash lye ($\frac{1}{12}$) gives far better results. The bacilli colour well, however, in gentian and methyl violets, but best of all in fuchsine. Weakly acid colouring solutions, or subsequent decolorisation in acidified alcohol, but especially treatment of the section with weak potash lye previous to staining, generally gives fairly distinct representations of the bacilli, which on the whole are difficult to stain. The intensity of the colouration is always much less than in the case of micrococci, which indeed is true of nearly all kinds of bacilli (EBERTH, WEIGERT), though lepra bacilli are still more rebellious to colouring matters than are their related forms. In gentian violet preparations protoplasm containing bacilli is distinguishable by its marked red tint from the blue nucleus.

Bismarck brown and all other brown and yellow dyes that I have employed fail completely to stain single bacilli in spite of all acid and alkaline modifications, such as the use of carbonate of potash, sulphate of zinc, alum, etc. Only the globi assume (just as all protoplasm does) a particularly strong colour in glycerine preparations. R. KOCH obtained slight staining with vesuvine.

Dahlia in acid solutions gives preparations that may be used.

Methyl blue (EHRlich), on the other hand, gives negative results as regards bacilli, but is specially adapted for the clear demonstration of vacuolation occurring in old lepra cells.

Neither nigrosin, aurantia nor methyl green stain bacilli.

Eosin does not colour single bacilli. On the other hand, an acid mixture of eosin and hæmatoxylin* may be used with great advantage. The sections are washed in water after staining, and then decolourised with alcohol. The nucleus then exhibits a beautiful blue tint, the ordinary cell protoplasm is eosin-rose, while the protoplasm of the cells containing bacilli is prominent by its clear orange, so that even with low powers the presence of bacilli can be established. Carmine stains neither bacilli nor globi, but rather indicates the latter in the skin, in the detritus of the spermatic tubules and among the bundles in peripheral nerves, as uncoloured, shining, yellow masses visible on the red background.

I should remark that lately in all my preparations the bacilli were often decolourised even after 24 hours, whether I had employed alcohol or oil of cloves or Canada balsam with or without chloroform. Light has no influence. On the other hand, certain sections furnished, two or three days after their preparation, much plainer images than directly upon being mounted. I have also sections in my possession which have now lasted for nearly two years in unchanged good condition. I have been unable to ascertain with certainty the reason of this variable behaviour, which must undoubtedly depend on the choice of staining agents and the different methods of hardening adopted, but in the interest of future investigations I have considered it my duty to call attention to this remarkable inconstancy in the results of staining.

III.

The micro-organisms when brought into view by the methods described (hardening in alcohol, staining in watery anilin solutions, decolourisation in absolute alcohol, oil of cloves, Canada balsam) appear

* I am indebted to EHRlich's memoir for the following formula:—

I.—Eosin	0.5	II.—Hæmatoxylin	0.5
Distilled water	100.0	Absolute alcohol	100.0
Alum	2.5		
Glycerine	100.0		

Mix I and II; then after three days, during which the mixture remains exposed to the light, add 2 per cent. of glacial acetic acid.

as very fine, slender rods, now and then slightly tapering at both ends, measuring in length about one-half or three-quarters of the diameter of a human red blood-corpuscle, and in breadth about one-fourth or less of their length. Rectilinear or slightly curved, they bear most resemblance to the minute bacilli which KOCH has figured in the septicæmia of the mouse, but the forms I describe are not so delicate as his.

In the place of a slender, uninjured bacillus we very frequently find small granular particles. These may be disintegration products, and in that case they are quite irregularly distributed through the protoplasm, and are of variable size; or the granular appearance is the sign of a progressive advance,—in fact, of a propagation. Finally, the presence of a comparatively wide mucoid sheath may be demonstrated.

For the study of these conditions we may employ the following methods:—

A.—Dry preparations of tubercle juice and of the pus as found in ulcers produced by the breaking down of tubercles. This pus is always rich in bacilli.

These dry preparations, however, offer very different appearances, according to their mode of preparation.

1. *When water is employed* (KOCH).—The specimen is stained, the surplus colouring matter is washed away with water, and after drying, the preparation is mounted in Canada balsam.

2. *When alcohol is used.*—After staining, the preparation is decolourised with alcohol. Then it is either (*a*) dried and examined in Canada balsam, or (*b*) it is immersed in oil of cloves, and subsequently mounted in Canada balsam.

The differences in the results of these two processes are very striking. In specimens prepared with water we see, both in the cell protoplasm and in the extra-cellular dried tissue juice, clear linear gaps exactly corresponding in size and arrangement with the well-known appearance of bacilli-charged cells. It only occasionally happens that the lumen of these chinks is not empty, but is occupied by a stained bacillus. The chinks are not of uniform length, but are always longer than they are broad. They are oval or go off to a point at one end in a drop-like or conical fashion.

Starting from the fact often observed by KOCH that, during drying, micro-organisms burst away from the covering glass, I had in my previous memoir considered these chinks as relics of escaped bacilli, and therefore hypothetically assumed the existence of a mucoid sheath.

This explanation now proved to be erroneous. For when a specimen, which when prepared with water exhibited only chinks, was subjected to treatment with alcohol, the presence of bacilli in large numbers could be demonstrated. Instead of clear spaces, the ordinary appearance presented itself of bacilli embedded in the protoplasm or free in the tissue juice.

At all events, this difference between the results of decolourisation by water and by alcohol proves that we have to do with a mucoid sheath loosely enveloping the entire bacterium. It is less easy to explain why the bacilli should become stained by the alcohol process. The hypothesis which at first sight seems most plausible, namely, that the mucoid sheath preventing colouration in the water process is removed by the alcohol, proves untenable, for the application of alcohol before staining does not induce subsequent colouration of the bacilli.

Perhaps the phenomenon depends on that inversion of staining, produced by alcohol, which has already been described by EHRLICH.

It is unnecessary to dilate on the advantages which the transparency and distinctness of these preparations offer for the study of bacilli.

It has to be remarked, in conclusion, that live, moving bacilli are always broader than dried ones, and the latter shrink still further when alcohol is used in their preparation.

B.—Breeding experiments.

1. A tubercle still covered by unbroken skin is thoroughly cleansed with alcohol and excised. Having been removed with the most minute precautions against outside contamination, it is divided with needles purified in the lamp. Three courses may then be adopted :—

a. Cultivation in blood serum in good-sized object cells with a plentiful supply of air.

b. Cultivation in blood serum with faintly alkaline and sterilised solution of meat extract, in test tubes which have been carefully purified with acids and boiling.

c. Cultivation under a covering glass with blood serum, precautions being taken against evaporation.

All these preparations are kept continuously in a warm chamber at a temperature of 35° to 39° C.

2. Pus and tubercle juices, protected from chance contamination, by enclosure in hermetically sealed glass tubes with a sufficient quantity of air, may be cultivated in these same tubes.

C.—Artificial necrosis of the tissue. Freshly excised tubercles* are introduced into the peritoneal cavity of a living rabbit. Provided antiseptic precautions are adopted, this has no injurious effect on the animal, peritonitis etc. never occurring. But through the influence of the living lymph the fragment introduced undergoes a metamorphosis of its chemical properties. That is to say, nuclei wither in a peculiar manner (WEIGERT), and cannot subsequently be stained. After from four to eight days the animal is killed, and the fragment, which is now enclosed in a capsule of connective tissue, is hardened and examined in the usual way. The fundamental tissue does not stain in the least, so that the colouration of the bacilli is all the more distinct, and they stand out with the utmost clearness.†

By the three modes of investigation just described (examination of dried preparations, cultivation, and artificial tissue destruction), results were obtained which I have endeavoured to detail and criticise in the most practical way. The difficulty encountered in cultivating these bacilli is very great, in consequence of the minuteness of the organisms, and it is moreover impossible to trace the fungi through the stages of their growth in living specimens. For culture must be interrupted and the specimen dried and coloured before examination is attempted. Then, again, we are without any reliable test of the accuracy of the investigations made, a test such as is afforded by the inoculation of animals in the case of bacillus anthracis, which would protect us against confounding the bacteria in our preparations, which we wish to describe, with others introduced by chance admixture. I have therefore been restricted in every case to visual comparisons when deciding as to whether in a given instance true leprous bacilli and their progeny were present. With regard to breeding experiments in particular, I would suppress their results, in spite of the conviction which I personally entertain, had I not been again and again able to confirm by preparations in which contamination was impossible (*viz.*, in dry preparations of tubercle juice, and in sections of lepra tubercles which had been lodged in an animal's peritoneum) the results obtained by cultivation.

I must add to what has been said about bacilli which have not been subjected to manipulation, that (as HANSEN has already stated) they exhibit movements in tubercle juice and pus extracted by pressure. I cannot positively decide whether they manifest merely an oscillatory motion to and fro, or at the same time rotate round their long axis. But my belief is that the latter supposition is the more probable, for which I shall give my reasons later.

Besides smooth bacilli, two forms are found :—

1. Rods with a globular enlargement at one end or at both ends or in the middle. These bacilli, which are often provided with several enlargements, vary much in length. If a slender normal bacterium be taken as unity, then those presenting a single enlargement are longer than the unit, but less than twice as long, while the many-globulated filaments are more than double the length of the unit. These filaments

* It results from SENFTLEBEN'S experiments that morsels previously hardened in alcohol are also suitable for this purpose. Of the accuracy of this I have convinced myself.

† I am at present engaged in testing this method in the course of other bacterial investigations.

are seldom rectilinear; they generally form an obtuse angle at the point of enlargement, but some are found wherein the enlargement forms the apex of a very acute angle. Again, there are rods which, instead of a globular enlargement at one end, present rather a lance-shaped prolongation, which starts from a broadened base, so that its tapering is sudden. Nearly every lepra cell contains such globules free in its interior, along with lanceolate or drop-like or conical forms in very large number. Hence we must not forget the possibility of confounding them with bacilli which are looked at perpendicularly from above.

These forms are also found free in prepared specimens of the fluids. Since dry preparations are largely decolourised by the alcohol and oil of clove treatment, while these granules always stand out very clearly as well-stained spheres, etc., sharply defined, and which can easily be distinguished from amorphous detritus, they also may perhaps be regarded as the progeny of bacilli.

Bacilli provided with globular enlargements exhibit movements when in the fresh state. In those containing a granule in the middle, and especially when the halves are inclined at an angle, a distinct whirling motion may be observed, which indicates rotation round their long axis. The addition of water makes the movement much more active (HANSEN).

2. The second form exhibits the following condition:—In the direction of the length of the bacterium, one, two or three clear unstained gaps are seen, which, as a rule, occupy the entire breadth, but are limited by a barely visible wall. Now and then the clear spot seemed to be placed unsymmetrically, closer to one border than to the other.

When only one clear spot existed it lay nearer to one end than to the other, but never quite at the point. To the uncoloured zone there was often attached not a normally broad continuation, but a lanceolate prolongation. I also sometimes saw two smaller bacilli, diverging from one another at an acute angle, apply themselves to the uncoloured region, and it seemed that they were not so placed by mere accident, but that they had combined to form a Y-shaped system.

The clear spaces are always smaller than the coloured intermediate parts. Thus, there would be $\frac{2}{5}$ coloured, $\frac{1}{5}$ uncoloured, $\frac{2}{5}$ coloured; or $\frac{2}{8}$ coloured, $\frac{1}{8}$ uncoloured, $\frac{2}{8}$ coloured, $\frac{1}{8}$ uncoloured, $\frac{2}{8}$ coloured. I found no isolated clear spherules with bounding surface alone stained.

Bacteria containing several chinks are always larger than the ordinary smooth bacilli, while such as contain a single chink are found among the smaller specimens.

Formerly I investigated only sections which had been prepared in the usual way. In these, it is true, bacteria with chinks and spherical enlargements came under my notice, but their appearance was explained erroneously in a manner which can be accounted for by the methods employed. I then wrote: "In the later stages we observe disintegration of the bacterium into granules which retain their longitudinal arrangement for a considerable time, perhaps in consequence of possessing a mucoid sheath, which, it must be confessed, is not visible in alcohol preparations. Whether this granulation does not indicate spore formation, and thus a process of development, rather than a regressive metamorphosis, is a question which it is necessarily impossible to decide by the study of dead material."

Now, however, we can arrive at a decision in an affirmative sense. Besides molecular disintegration of bacteria, there occurs a formation of spherules and chinks, and thus it is not the stained portions but the unstainable intermediate regions which present us with new facts. In this connexion, dry preparations after simple water treatment were specially demonstrative whenever the contents of the mucoid sheaths which formerly looked like linear chinks had by chance shared in the staining. In that case one often sees within the compass of a cell, a gap containing two or three bacilli, one of which may be unchanged, another with clear unstained intermediate parts, and so on. Moreover, short spaces are found with correspondingly short, conically-pointed contents.

There is, finally, a third mode of growth which came under observation alike in cultures and in tubercles introduced into the peritoneum. This is the stretching of bacilli into filaments about four times

as long as an ordinary bacterium. These lay together in heaps parallel to one another or irregularly interlacing, just as do ordinary bacilli. Bacilli massed in throngs were also found in the chamber cultures. I was never able, however, to satisfy myself as to spore formation in these filaments.

Such are the results of my observations in the matter of development. After frequently repeated tests, I have no doubt as to their validity.

There are familiar analogies which we may draw from many bacillary forms in illustration of the various stages here described. We thus gain more confidence in the assumption that globular and "fissure-bacilli" are spore formations. Thus, for instance, in one of KOCH's photographs, "a small cylindrical bacillus with four equidistant spores" is an excellent representation of the objects we are considering. The spheroidal spores are also represented in the same plate.

In regard to pathogenic bacteria, the bacillus malarie offers, perhaps, some analogies. More particularly, the remarkable phenomenon of two modes of development, viz., spherule- and gap-formation, is found in this organism likewise.

No matter how exact the above detailed isolated observations may be, I nevertheless consider it impossible to construct from them the complete developmental history of the bacillus lepræ. Inasmuch as the causes which sometimes produce spherical spores and sometimes gap formation remain hidden, while progressive development could never be watched in any individual bacillus, I refrain from discussing in a hypothetical way a matter which can be cleared up by observation only.

So far we have been able to establish that a definite, typically recurrent bacillus-form is found wherever leprous new growths exist, and, further, that in the body, just as in cultivations, this bacillus is propagated by spores. It remains now to show :—

1. That these bacilli and spores are the cause of the new growths.
2. The route along which they spread within the body.

IV.

No direct proof of the first proposition can be assigned, such as may be set forth in the case of splenic fever. Yet the assumption is so well supported, despite all the defects in our botanical knowledge of the fungus, that leprosy as a disease produced by bacilli may safely be ranged in the class of acknowledged bacterial diseases along with relapsing fever, ulcerative endocarditis, etc.

In the first place, there is the absolute constancy wherewith the bacillus is found in all leprous new growths, and the nearly invariable presence of a quantity of fungus corresponding in its abundance with the extent of diseased tissue. This fact presented itself over and over again in the same convincing manner during the study of lepra material from Norway, Spain, Guyana, India, Roumania, Brazil and Palestine.

We shall, moreover, be able to prove that as a consequence of the presence of bacillus lepræ the normal developmental progress of a wandering cell into a connective tissue cell sustains an alteration which results in the formation of what, after VIRCHOW, we shortly indicate by the term lepra cell. If such a relation may invariably be observed, we are justified in concluding that the specific form and nature of the lepra cell are etiologically decided by the specific bacillus.

I appeal here to two series of observations :—

A.—Investigation of the granulations which spring up after the loss of substance caused by excision of a broad skin tubercle.

In a perpendicular section stained in the ordinary way the lower stratum is very rich in cells as compared with the superficial portion. The latter, moreover, contains no blood-vessels, which lower down are very numerous and of large size, quite out of proportion to the thickness of their walls. The cells are embedded in an uncoloured filamentary matrix which looks like coagulated fibrine, and are generally of the size of a white blood-corpuscle. They

contain a large, deeply-tinted nucleus which nearly fills the interior of the cell. Now and then, instead of this single nucleus several small nuclei are present. At the same time epithelioid cells of the most varied forms are plentiful, especially in the neighbourhood of the blood-vessels, and, finally, we find some young spindle-shaped connective tissue cells fully grown.

In remarkable contrast with these small cells, there are others five or six times as large, with very bulky, clear vesicular nuclei, and containing a large number of beautiful smooth bacilli with or without spheroidal spores.

Sometimes these cells appear to lie singly or in groups within chinks in the matrix. Giant cells possessing three or four nuclei, and with or without bacilli, are not uncommon. Besides well-preserved rods there are also smaller conically-tapering corpuscles, which are not to be confounded with bacilli that are looked at obliquely or vertically. I would add that granulations spring up very quickly on lepra-excision wounds. Cicatrisation is long retarded by the formation of a crust of dried granulations.

B.—Experiments on animals seem to me still more decisive. These were performed fourteen times on rabbits and five times on dogs. On the 6th November a freshly extirpated tubercle was, with strictly antiseptic precautions, introduced into the peritoneal cavity of a rabbit, and the animal was killed on the 11th. Postmortem examination revealed the fragment enclosed in an extremely vascular connective tissue capsule attached to the great omentum. Under the microscope I found that the original mass of tubercle had been destroyed by necrosis. No nucleus was made visible by staining. It was only the arrangement of the well-coloured bacillus piles that still indicated the position of the tubercle cells which had previously formed the groundwork. Next in order, externally, there was a zone of granular detritus so densely heaped together that amid it it was impossible to make out anything about bacilli. In the connective tissue region next following, I could trace in layers from the centre to the periphery all the stages of inflammation and of inflammatory connective tissue development up to the formation of the ordinary, small, clear, caudate connective tissue cells. This region contains, in considerable numbers, remarkably large, round, elliptical and elongated bacilli-charged cells, with large, clear nuclei. As regards their form, they occupy an intermediate position between epithelioid and fully grown connective tissue cells. In the newly-formed finely filamentous connective tissue of the enclosing capsule there are, moreover, unmistakable bacilli-charged cells in which bacteria, either in little heaps or scattered singly, lie near the nuclei. Bacilli-charged cells can everywhere be distinguished by their size and by their arrested development, as compared with neighbouring coeval cells of the same layers. It is also worthy of notice that the bacilli chiefly assume the form of smooth, intact bacteria.

Although in the rabbit these large bacilli-charged wandering cells soon perish, so that when the experiment was prolonged no trace of them was to be found in the connective tissue capsule, a new leprous formation is obtained in the case of dogs.

In these latter the subcutaneous connective tissue was chosen for the deposition of freshly removed tubercle. In one animal the piece introduced had at the end of 21 days disappeared without leaving a trace. A second, operated upon on the 16th October, died on the 18th November. A delicate, yellowish-brown fragment about the size of a lentil, and surrounded by filamentary connective tissue, was found under the scar. Microscopically examined it exhibited clear cells, with round, bulky, moderately dark stained nuclei, densely infiltrating a fine filamentary connective tissue. All these cells, which in size greatly surpass wandering cells, and give the impression of being very young, contain many bacilli and small rather granular forms. On the border of this mass, consisting of oval cells, thin layers of spindle-shaped connective tissue cells, closely pressed together, are deposited, whose protoplasm also occasionally contains bacilli. Blood-vessels were distributed in fair numbers through the little tumour.

More interesting still was the result obtained in the case of a fourth dog, operated upon on the 16th October, and killed on the 6th January, wherein, even during life, a slowly-increasing tumour could be felt under the scar of the incision. Macroscopically, a bean-sized tumour, yellowish-grey, and of firm consistence, was distinguishable from the surrounding connective tissue, but was above continuous with

the scar in the corium. Under the microscope this tumour was found to consist of very voluminous epithelioid cells, which were undoubtedly leprous, but nowhere was there a trace of bacilli to be found.

So far as I can see, these results are susceptible of but one explanation. Inasmuch as transplanted human tubercles are incapable of living so long as from 4 to 11 weeks, the tumours discovered must have been newly formed. Specially demonstrative of this is the fact that all the nuclei stained well and regularly, though we know that the nuclei of cell masses always vanish when introduced into a living body. Hence the leprous substance introduced must have been absorbed, and replaced by a new growth. This new growth originated in an inflammatory process whose immediate products,—namely, wandering cells,—pursued a specific course in two directions under the active influence of the intruding bacilli. On the one hand, development tending to the genesis of connective tissue was arrested at an incomplete stage, which but rarely advances to the formation of spindle-shaped paratypical connective tissue cells. On the other hand, we find something specific in the persistency of single cells whose tardy development harmonises with the sparsity of the newly-forming blood-vessels. This observation is confirmed by the fact of the long unchanged condition of lepra nodules in man.

That in the case of these dogs we had to deal with a true local leprosy in the animals used, seems to me so certain that even from the instance of new growth without bacilli related as the second case, I should be disposed to draw a converse conclusion. This result proves, in my opinion, that lepra bacilli produce specific neoplasms from which the bacilli, after they have discharged their special functions, disappear as such, and that inasmuch as the bacilli may either have perished or have assumed the transitory condition of spores, the absence of organisms does not of itself pronounce against the leprous character of a neoplasm. Such observations cannot be made in men, as in their wandering cells and nutritive juices the bacillus finds the material necessary to its development, and so leprosy becomes a constitutional disease. In dogs, to judge by the experiments hitherto made, the chances of general infection are limited, nothing more than local, transitory leprous neoplasms being producible. Yet the possibility, after more extended trials, of imparting generalised leprosy to dogs must not therefore be denied. Rabbits seem totally incapable of nourishing the bacilli, death of transplanted fungus masses being at the farthest but a question of days. Attempts to produce infection by introducing leprous material into the anterior chamber proved fruitless. Little masses which had been transplanted with so many precautions that they caused no inflammation or other trouble, remained nearly unchanged for 62 days, showing only a hardly perceptible diminution in size.

V.

As regards the course pursued by the bacilli when distributing themselves through the body, there are two routes open, namely, the blood-vascular system and the lymphatic system.

Under ordinary circumstances, the blood, according to all the observations that I have hitherto made, does not, however, seem to offer a channel to either bacilli or spores.

1. Tissue preparations never gave any satisfactory evidence of the presence of bacilli or spores.
2. Examinations of blood, fresh, dried and stained in all possible ways, invariably gave negative results.
3. Breeding experiments made with blood drawn from the healthy portions of a patient's skin were fruitless. On the other hand, unmistakable bacilli developed in the most satisfactory manner in blood obtained by puncturing tubercle nodules. Whence it follows that it was not in the blood itself* that the

*I cite here an adverse opinion. On the 11th December 1880 MM. GAUCHER and HILLAIRET communicated the results of their investigations into the subject of lepra-parasites to the Société de Biologie. They found in blood drawn from the point of the finger, and especially from tubercles, a tolerably large number of bacteria, most of which were moving, some punctiform, others rod-like, with occasional small rows of monads lying in groups of two or three. They were successful in cultivating the bacteria. Blood preserved between two glasses contained, when examined at the expiration of three weeks, a considerable number of motionless monads, chains of articulated monads, bacteria, and even long-branched filaments, which for the most part appeared to be jointed in several places, and were on the whole suggestive of mycelium filaments.

spores were sheltered, but that by puncture of the nodule, other material containing spores was permitted to mingle with the blood as it flowed.

Such nodule blood when dried and examined showed only an increase of white blood-corpuscles, which appeared under two forms:—

a. Large cells with clear protoplasm and several small nuclei, which, like pus-corpuscles, assume all possible forms.

b. Smaller round cells with a large oval nucleus, the protoplasm containing delicate, well-defined, distinctly-stained granules (spores?) in remarkable numbers.

Breeding experiments from this blood—

1. In object cells,
2. In capillary tubes sealed at both ends, with a sufficient supply of air,
3. In test tubes,

yielded forms which appeared to me to demonstrate indubitably the growth of bacilli from small conical granules.

I reproduce the notes of one experiment:—

Blood drawn 25th November. Tube opened 5th December, and several dry preparations made, which were mostly stained with gentian and afterwards treated with alcohol. No blood-corpuscles plainly visible. From the diffused clear blue mass isolated violet-red heaps stand out, which under a $\frac{1}{2}$ oil immersion lens by ZEISS and No. 2 eyepiece can hardly be resolved into their ultimate constituent elements. With eyepieces 4 and 5, however, small, elongated, conically-pointed corpuscles lying close together in heaps, are everywhere manifest. In breadth they correspond with the bacilli. On one side of the pile delicate bacteria, indistinguishable from lepra-bacilli, are clearly recognisable. In Bismarck brown the mass stains as a whole, but not the separate elements.

In spite of the most careful examination and trials constantly renewed, control-breeding experiments with blood drawn from healthy persons invariably gave negative results.

I presume, therefore, that spores from the lymphatic lacunæ, and especially from the lymphatic spaces surrounding the capillary network, mingled with the blood drawn for cultivation; and I also conclude that it is the lymph vascular system which commonly opens a route to the spores.

In favour of this view I may further call attention to—

1. The arrangement of infiltrations round the adventitia of the blood-vessels, which, as is well known, contains lymph spaces, while no bacilli could be demonstrated satisfactorily in the blood-vessels themselves.

2. The clinical fact that not only the first manifestation of tubercular eruptions on the skin, but also their subsequent outbursts, are attended by erysipelatous dermatites, which, especially since KOCH's recent researches, we recognise as affections of the lymph vascular system. Norwegian and Spanish observers are unanimous in asserting that suppuration does not occur, and this enables us to mark off the special character of this affection, which is allied to erysipelas. On the other hand, the skin inflammations tend to local recovery in the regions attacked; the tubercle disappears, leaving brown patches behind, which contain much amorphous blood pigment. But they always produce an aggravation of the general process with renewed leprous eruptions in other portions of the skin, or, in other words, a great migration of fungi from one region to another.

It is worthy of consideration whether, under this erysipelatous condition, the blood-vascular system may not share in the transport of spores. I have, unfortunately, had no opportunity of examining and cultivating blood drawn from unaffected portions of the skin during this state of things.

The results of treatment by application of chrysophanic acid also show that superficial dermatites are followed by the resorption phenomena described.

3. Experiments on animals, as fully detailed above,—namely, introduction of freshly extirpated tubercles within the bodies of rabbits and dogs,—prove that migration of bacilli and spores occurs without the co-operation of the blood-vessels.

Bacilli are found in the cells of the connective tissue capsule far removed from the centrally-enclosed tubercle. They could have got into this position only by themselves wandering in the intercellular spaces,—where, in fact, they were discovered,—or by the intermediary of centrifugally travelling white blood-corpuscles.

We may presume that it is only spores that are transported, while local advance of leprous infiltration is effected by the peripheral migration of bacilli, as, for instance, in the cornea.

Certain tissues enjoy a physiological immunity from bacillus-invasion. Such are all epithelial structures, hair [skin] glands and rete Malpighii.

We cannot as yet explain satisfactorily, on anatomical grounds, the interesting facts recorded by Dr. BOECKMANN of Bergen. He found that [during bacterial invasion] of the cornea, opacity spreading from one limb halted at the scar of a dissection wound, so that the portion lying on the other side of the cicatrix remained transparent. We must at any rate admit that the scar hindered the further march of the bacilli.

4. Finally, the remarkable tumefaction of lymph glands that are densely stuffed with bacilli, and their great sensitiveness to pain during the course of the erysipelatous affections above described as accompanying each outburst, support the assumption that the lymph-vascular system is the channel along which spores and bacilli advance.

In but one manner can we admit that the blood-vessels co-operate. The inflammatory alteration of the vascular walls produced by the bacilli and spores present in the perivascular lymph spaces, favours diapedesis, and so supplies white blood-corpuscles to form the foundation for leprous neoplasms.

VI.

From all the considerations above enumerated, the following conclusions may be derived:—

1. Leprosy is a genuine bacterial disease dependent on a specific bacillus form. In favour of this are to be cited: the constancy and certainty wherewith bacilli are found; their special character; their occurrence in all the organs attacked, and in quantity corresponding with the severity of the disease; the fact that the specific properties of lepra cells can be artificially reproduced by the introduction of bacilli.

2. These organisms enter the economy either as bacilli, or, more probably, as spores. They remain in an incubative stage, which varies in duration according to circumstances, deposited in some place of refuge, perhaps the lymphatic glands. The duration of incubation is remarkably variable when studied in cases of leprosy itself, and is especially so when compared with that of other infective diseases. The physiological resistance of the human system is the more marked as the power of growth displayed by the bacilli is less. Incubation and subsequent career appear, however, to be much more rapid in tropical regions than in European lepra districts.

3. From these places of refuge invasion of the body occurs, chiefly at the expense of—

a. The skin (*lepra tuberculosa*), as in the case of variola, syphilis, etc. The regions which under other circumstances are obnoxious to external lesions are special seats of lepra predilection; for instance, the face, hands, elbows and knees.

b. The peripheral nerves (*lepra anæsthetica*). The muscular symptoms and trophic disturbances correspond to those with which we are familiar in other diseases of peripheral nerves.

c. Other organs, such as the testicle, spleen, cornea, cartilage and liver. These share to a less extent in the process.

4. Bacilli or spores produce inflammation of vascular organs, and in non-vascular organs there is centripetal invasion from the periphery. The lymph cells (and fixed elements?) then supply material for the leprous neoplasm. Through the specific operation of bacilli, wandering cells become lepra cells, characterised by the peculiarity of their form, course and termination.

5. From these premisses we may assert the probability of leprosy being a disease of infection, and contagious by means of its specific products. These are tubercle cells, tissue juice and pus containing

bacilli or spores that are capable of living. Not every specimen of pus taken from a leprous patient is infective. It may contain no bacilli, and be just as little infective as the contents of pemphigus bullæ.

The disease, of course, is not only directly contagious but may also be communicated indirectly through any articles conveying bacilli or spores. I have already insisted on the fact that in leprosy, more than in other bacterial diseases, individual susceptibility is an important consideration.

On the other hand, leprosy is not, in my opinion, transmissible by inheritance.

[*Memorandum.*—In France, M. CORNIL has lately paid much attention to the organisms associated with leprosy. He fails to find them in the epidermis, and he thus explains the non-contagious character of the disease. He reports that in one of his observations the tissues were so stuffed with bacteria and so changed thereby that it was difficult to determine what organ was under examination. The organisms presented themselves under the forms of spores; excessively small and delicate rods; bulky rods containing granules; long filaments formed of articulated bacteria, the joints being separated by transparent partitions; etc. The lesions explicable by the presence of parasites are divisible into three series. In the first are placed the formation of leprous tubercles, and the occurrence of leprous infiltration characterised by the invasion of multitudes of large cells crowded with delicate bacteria. When a soft organ such as the liver, or a cavernous organ like the testicle, is thus infiltrated, the bacteria, encountering no resistance, assume a very large size. Blood circulation is diminished or abolished, and the capillary vessels are filled with bacterial infarcts. Hence the infiltrated tissues become almost gangrenous, and ulcerate when they form part of the skin or of a mucous surface. To the second series belong lesions of fibrous tissues, such as the cornea, sclerotic, peripheral nerves, arterial coats, etc. Here the bacteria send long filaments into the connective interstices between the lamellæ. These filaments may attain the length of $\frac{1}{10}$ millimètre. Some present a globular enlargement at one end, and contain transparent elements which are probably spores. The fixed cells of the invaded tissue are but slightly, if at all, changed; but sclerosis is frequently produced by thickening of the connective layers. Finally, free or aggregated spores are to be found in the protoplasm of cells, in the detritus of the spermatie tubules, and in the blood-vessels.

In clinical confirmation of the parasitic nature of the disease, M. LABBÉ claims success for a treatment consisting of daily repeated subcutaneous injections of carbolic acid.]



II.—SPECIAL SERIES.

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„ 3.—SILK : Published, 1881.
„ 4.—OPIUM : „ 1881.
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